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PENSOFT

Survey of the vascular plants of Alert (Ellesmere Island, Canada), a polar desert at the northern tip of the Americas

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Abstract

Long-term monitoring is critical to guide conservation strategies and assess the impacts of climatic changes and anthropogenic activities. In High Arctic ecosystems, information on distribution and population trends of plants is dramatically lacking. During two field expeditions in 2018 and 2019, we conducted a systematic floristic survey together with opportunistic collecting in the polar desert surrounding Alert (Nunavut, Canada) to update past vascular plant inventories. We recorded 58 species, of which 54 species were recorded over the last seven decades, and four species that are additions to the local flora (*Draba pauciflora* R. Brown, *Festuca edlundiae* S.G. Aiken, Consaul, & Lefkovitch, *Festuca hyperborea* Holmen ex Frederiksen, and ×*Pucciphippsia vacillans* (T. Fries) Tzvelev). With the addition of 19 species that were previously reported but not found in our survey, we estimate the species richness in the study area at 77 species.

Keywords

Arctic endemic species, Floristic inventory, High Arctic, imperiled species, northern distribution

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Introduction

Polar deserts are among the most extreme environments in the world. These seemingly barren landscapes are characterized by a short growing season, low annual and summer mean temperatures, low precipitations, severe limitation in nutrients, and soil disturbance due to freeze-thaw cycles (Billings 1987; Peterson 2014). Because of these important environmental constraints, High Arctic ecosystems support persistent but sparse and short vegetation (Bliss and Svoboda 1984; Bliss et al. 1984; Lévesque 1997; Peterson 2014; Zwolicki et al. 2020). These ecosystems are expected to be the most impacted by the ongoing climate change due to Arctic amplification, which refers to the greater climatic changes occurring near the North pole compared to the rest of the globe (Smith et al. 2019). With the steep climate warming occurring over the last decades (Meehl et al. 2007), Arctic regions have already experienced changes in vegetation composition, biomass, and diversity (Elmendorf et al. 2012a, 2012b; Ravolainen et al. 2020). Therefore, establishing ecological baselines and updating past inventories are critical scientific endeavors to monitor, predict, and manage current and future impacts of climate change (Mihoub et al. 2017). Despite the remoteness and considerable logistical constraints associated with working in the High Arctic, there is a long history of botanical collecting at High Arctic research stations, particularly in the mid-20th century (Panchen et al. 2019). However, current collections from some High Arctic locales are lacking and synthesized, published data regarding plant biodiversity in polar deserts remains scarce (CAFF 2013).

Located at the northern tip of Ellesmere Island in the Canadian Arctic Archipelago, only 817 km from the North Pole, Alert is the northernmost permanently inhabited settlement on Earth. Here, an Environment and Climate Change Canada weather station operates year-round, and a Canadian Forces Station (CFS Alert) was established in 1958 (Johnson 1990). The Alert region is characterized by continuous permafrost and is one of the most arid places in the Northern Hemisphere (Parks Canada 1994). Alert occurs in Circumpolar Arctic Bioclimate Subzone A, which is the coldest bioclimate subzone in the Canadian Arctic, with an average July temperature of 3°C (CAVM Team 2003). This subzone landscape is mostly barren, with some lichen and moss cover, and a <5% vascular plant cover (CAVM Team 2003; Christensen et al. 2013).

The history of vascular plant collecting in the Alert region began with the British Arctic Expedition in 1875–1876, when H.W. Feilden, the expedition's naturalist, made the first known vascular plant collections from the site (Bruggemann and Calder 1953). Later, during R. Peary's expeditions to the North Pole in 1905–1906 and 1908–1909, plants were collected by expedition members L.J. Wolf, R.A. Bartlett, and J.W. Goosdell (Bruggemann and Calder 1953). It was only during the establishment of the weather station at Alert in 1950 that the next plant collections occurred. From April to September 1950, an airstrip mechanic, J.P. Johnson was sent to Alert, where he explored the area and collected various samples (Johnson 1990), including vascular plants deposited at the National Herbarium of Canada at the Canadian Museum of Nature (CAN; herbarium acronyms follow Thiers 2020). In subsequent years, collections of the local flora greatly expanded. From April to September 1951, P.F. Bruggemann collected insects and carried out botanical investigations for the Northern Insect Survey at and around Alert, at Mt. Grant in the United States Range, and at the Wood River, located 40 km and 65 km west of Alert, respectively (Bruggemann and Calder 1953). During the botanical survey, Bruggemann was accompanied by S.D. MacDonald of the National Museum of Canada (the precursor to the Canadian Museum of Nature); MacDonald deposited vascular plants of his own collecting at the National Herbarium of Canada (CAN). Bruggemann deposited his collection at National Collection of Vascular Plants at Agriculture and Agri-Food Canada (DAO) and later summarized his own 1951 vascular plant inventory with the addition of the previous regional surveys from Feilden in 1875–1876, Bartlett in 1908, and Polunin in 1940 (Bruggemann and Calder 1953). In this paper, he also estimated that 65 species of vascular plants were present in the eastern Canadian Arctic north of 82°N. In 1952, P. Gadbois and C. Laverdière, from Université de Montréal, were sent to Alert by the Canadian Department of Mines and Technical Surveys to perform geographical surveys and mapping of the region (Gadbois and Laverdière 1954). They made several vascular plant samplings deposited at the Marie-Victorin Herbarium (MT) (Gadbois and Laverdière 1954). During the International Geophysical Year from 1957 to 1959, botanists, glaciologists, limnologists, earth science researchers, and biologists were sent to Alert. Among them, C.R. Harington went back to Alert in 1959, where he also collected many plant specimens (GBIF 2020). Following this, K.V. Pilon in 1975, D. Drew in 1976, and R. Pomerleau in 1983 collected vascular plant specimens at Alert that they deposited at the University of British Columbia Herbarium (UBC), Canadian Museum of Nature (CAN), and Louis-Marie Herbarium (QFA), respectively (GBIF 2020).

Here, we report the results of a systematically conducted vascular plant survey supplemented with opportunistic collecting in the polar desert surrounding Alert in 2018–2019. This provides a current inventory of the vascular plants, and a temporal snapshot of current species diversity to inform continued botanical work at the station.

Study Area

Our study area surrounds CFS Alert (82°30′N, 062°20′W) and is located on the north-eastern tip of Ellesmere Island, Nunavut, Canada (Fig. 1). It is roughly delimited

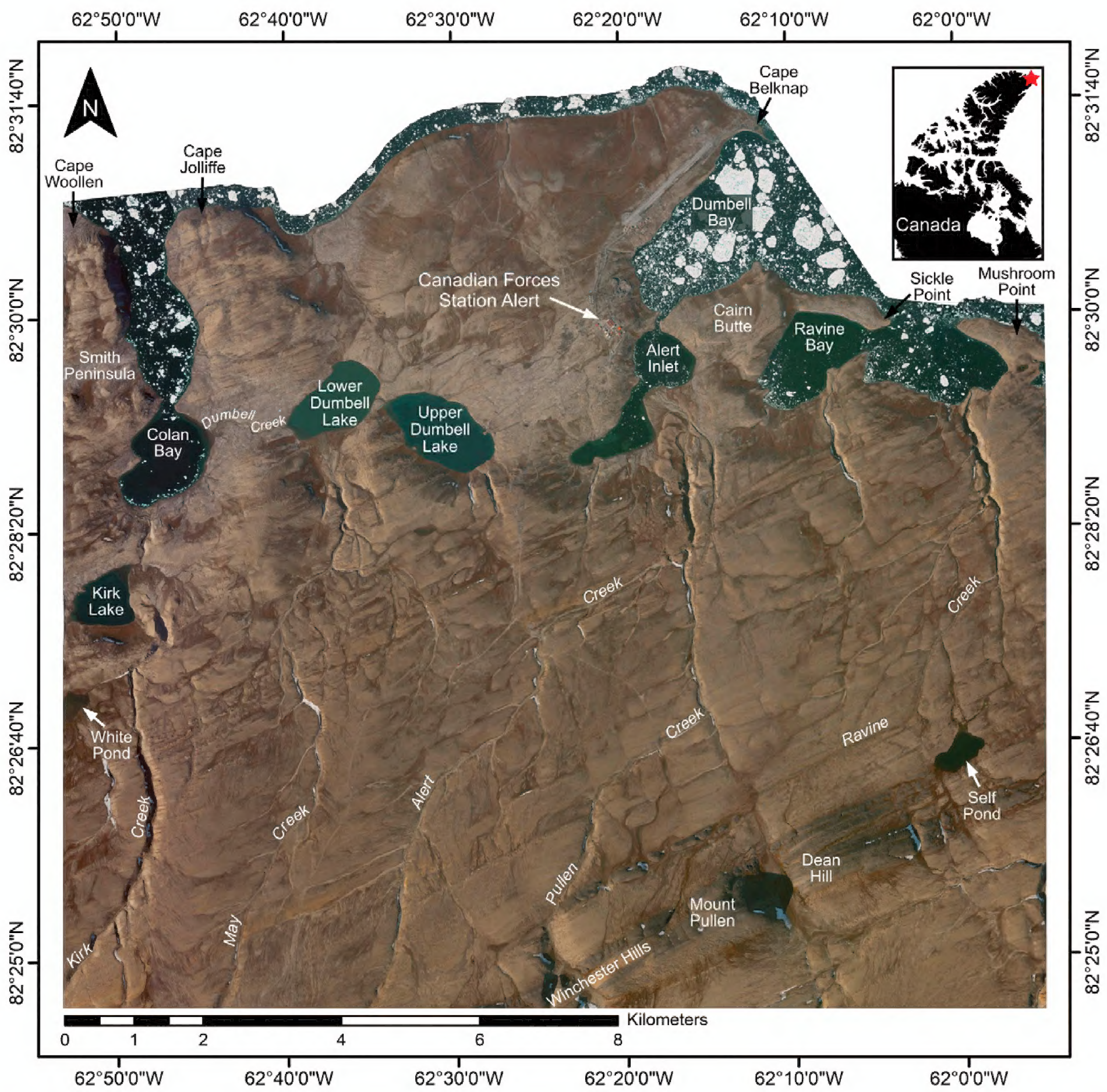

Figure 1. Pan-sharpened multispectral satellite picture of the study area at the north-eastern tip of Canada (WorldView-2/3; 2 and 13 August 2015). The map boundaries correspond to the study area indicated by a red star in the inset.

by the Lincoln Sea to the north and the boundaries of CFS Alert property in other directions. The study site encloses an area of 170 km^2, including five lakes (White Pond [0.12 km^2], Self Pond [0.25 km^2], Kirk Lake [0.58 km^2], Lower Dumbell Lake [0.94 km^2], Upper Dumbell Lake [1.18 km^2]), three bays (Ravine Bay [3.01 km^2], Colan Bay [3.49 km^2], Dumbell Bay [4.65 km^2]), and one inlet (Alert Inlet [1.09 km^2]). The local topography consists of rugged and undulating terrain with mountains (to a maximum height of 525 m a.s.l.), hills, valleys, and creeks. The surficial deposit ranges from 2.4 to 4 m thick and is mostly composed of till (sandy clay loam) and shattered rock filled with ice (Taylor et al. 1982; Tam 2014). The underlying bedrock is highly calcareous, composed of argillite with greywacke in some places, and the permafrost is >600 m thick (Smith et al. 2012). Because of isostatic rebound, the post-glacial marine limit is estimated at 135 m a.s.l (England 1976) and many beds of marine silts and clays occur, containing masses of recent marine shells (Bruggemann and Calder 1953). No glacial striae, trough-shaped valleys, or cirques are observed at Alert, and the present topography has been shaped entirely by water erosion and frost action (Bruggemann and Calder 1953). Alert is free of the Innuitian Ice Sheet since ~9.6 ka calibrated BP (Dalton et al. 2020). The uplands are mostly mesic, xeric, or barren, and consist mainly of boulder, frost-shattered rock, gravel, and polygonal nets of till, with very low vegetation cover growing inside soil interstices. In the lowlands, where some soil moisture accumulates, a more continuous vegetation cover develops, consisting primarily of grasses and sedges (Bruggemann and Calder 1953).

At Alert, a 24-h direct sunlight period occurs from early April to early September, while the sun remains

under the horizon from mid-October to late February. July temperatures average 3.4 °C and annual snowfall and rainfall average respectively 184.6 and 1.7 cm (corresponding to a combined water equivalent of 158 mm; Government of Canada 2010). The ground is generally covered with snow from early September to mid-June, leaving only about 2.5 months per year for plant growth (E Desjardins, S Lai, and D Berteaux personal observations).

Methods

Data collection. The floristic study was carried out during two field expeditions between 26 June and 24 August 2018, and 25 June and 4 September 2019. We conducted a systematic survey, which involved a random stratified design, as described below. The survey was supplemented with opportunistic sampling, collecting vascular plants of interest along marked trails and while traveling within the study area.

Selection of survey locations. We selected systematic survey locations based on a habitat map (Appendix 1) constructed from a multispectral satellite picture of the study area (Fig. 1). The habitat map consisted of six classes, including snow/water and five broad vegetation gradients classified into habitat types, namely barren ground, xeric, xeric-mesic, mesic, and wetland (Fig. 2). A 2 × 2 km grid was overlaid on the study area and, for each grid cell, we performed vegetation surveys at one or more random locations for each of the five habitat types present in the grid (Fig. 3A). ArcGIS 10.6.1 (ESRI 2018) was used to complete these steps.

Field surveys. Each vegetation survey corresponded to a vegetation plot consisting of five 1 m × 1 m quadrats, each located 5 m from a central point and at equal distance from one another (Fig. 3B; Bay 1998). All species inside the quadrats (Fig. 3C) were identified and recorded (Fig. 3D). If a species was opportunistically encountered at a surveyed site but out of a quadrat, specimens were collected to contribute to our floristic survey.

Specimen collection. The first flowering (or fruiting) specimens encountered of each species (in or outside the vegetation plots) were collected and dried in a standard plant press. Specimens were identified subsequently by the authors (ED, SL, SP, MD, PS, AS, JL, and LS) using keys from the Flora of the Canadian Arctic Archipelago (Aiken et al. 2007), Flora of North America North of Mexico (Flora of North America Editorial Committee 1993, 1997, 2000, 2002, 2005, 2006, 2007, 2009, 2010, 2014), Flore nordique du Québec et du Labrador (Payette 2013, 2015, 2018), Vascular Plants of Continental Northwest Territories, Canada (Porsild and Cody 1980), The Flora of Canada (Scoggan 1978a, 1978b, 1979), and other taxonomic literature (Aiken et al. 1995; Aares et al. 2000; Brysting and Elven 2000; Consaul and Gillespie 2001; Harris 2006; Consaul et al. 2008a, 2008b; Elven and Al-Shehbaz 2008; Al-Shehbaz and Mulligan 2013; Saarela et al. 2020; Solstad and Elven, unpublished). Collected specimens were also compared to those conserved at the Louis-Marie Herbarium (Université Laval, Quebec City, Quebec, Canada). Species names were updated based on the Database of Vascular Plants of Canada (VASCAN) (Brouillet et al. 2010+; Desmet and Brouillet 2013) and synonyms used in Saarela et al. 2020 (and other current Arctic floristic treatments; Elven et al. 2011) are also indicated. These specimens are deposited at the Louis-Marie Herbarium (QFA), with duplicates deposited at the Canadian Museum of Nature Herbarium (CAN).

Vascular plant descriptions and comparisons. Descriptions of species include their plant habit and distinctive characteristics and are roughly organized according to the template provided by Aiken et al. (2007). All size measurements and character states (e.g., pubescence, shape, color) represent specimens collected at Alert. Species descriptions are based on at least 10 specimens of various sizes, with the exception of *Draba pauciflora* R. Brown and *Pedicularis hirsuta* Linnaeus, for which only three specimens were available. In the species comparisons, we indicate the characteristics which, based on literature sources, are important to distinguish a given species from congeneric species found at Alert or elsewhere on Ellesmere Island. We also indicate when our collected specimens present characteristics that do not fully correspond to those reported in published floras. Botanical terms used in the descriptions and comparisons follow Beentje (2016) and Payette (2013, 2015, 2018).

Vascular plant habitats. The main habitat of each species was determined as follows. For species recorded in vegetation plots, we considered the species' main habitat as the habitat with the highest frequency of occurrence (highest number of vegetation plots). For species recorded only opportunistically (i.e., outside vegetation plots), we copied the GPS location of the collection on our habitat map to identify the species habitat.

Results

We conducted a total of 264 vegetation surveys, hence systematically inventorying 1,320 quadrats of 1 m^2 each. The xeric and xeric-mesic habitats were too similar to be distinguished in the field. We, therefore, merged them in the xeric class for further analyses, yielding four main vegetated habitat types (Table 1).

We found 58 species during our systematic surveys and opportunistic collecting in 2018 and 2019, distributed among 33 genera and 14 families (Table 1). We found four species through opportunistic collections (*Carex aquatilis* Wahlenberg var. *minor* Boott, *Eriophorum scheuchzeri* Hoppe subsp. *arcticum* Novoselova, *Puccinellia phryganodes* (Trinius) Scribner & Merrill subsp. *neoarctica* (Á. Löve & D. Löve) Elven, and *Saxifraga tricuspidata* Rottbøll) not recorded during the systematic approach. This result highlights the need to use

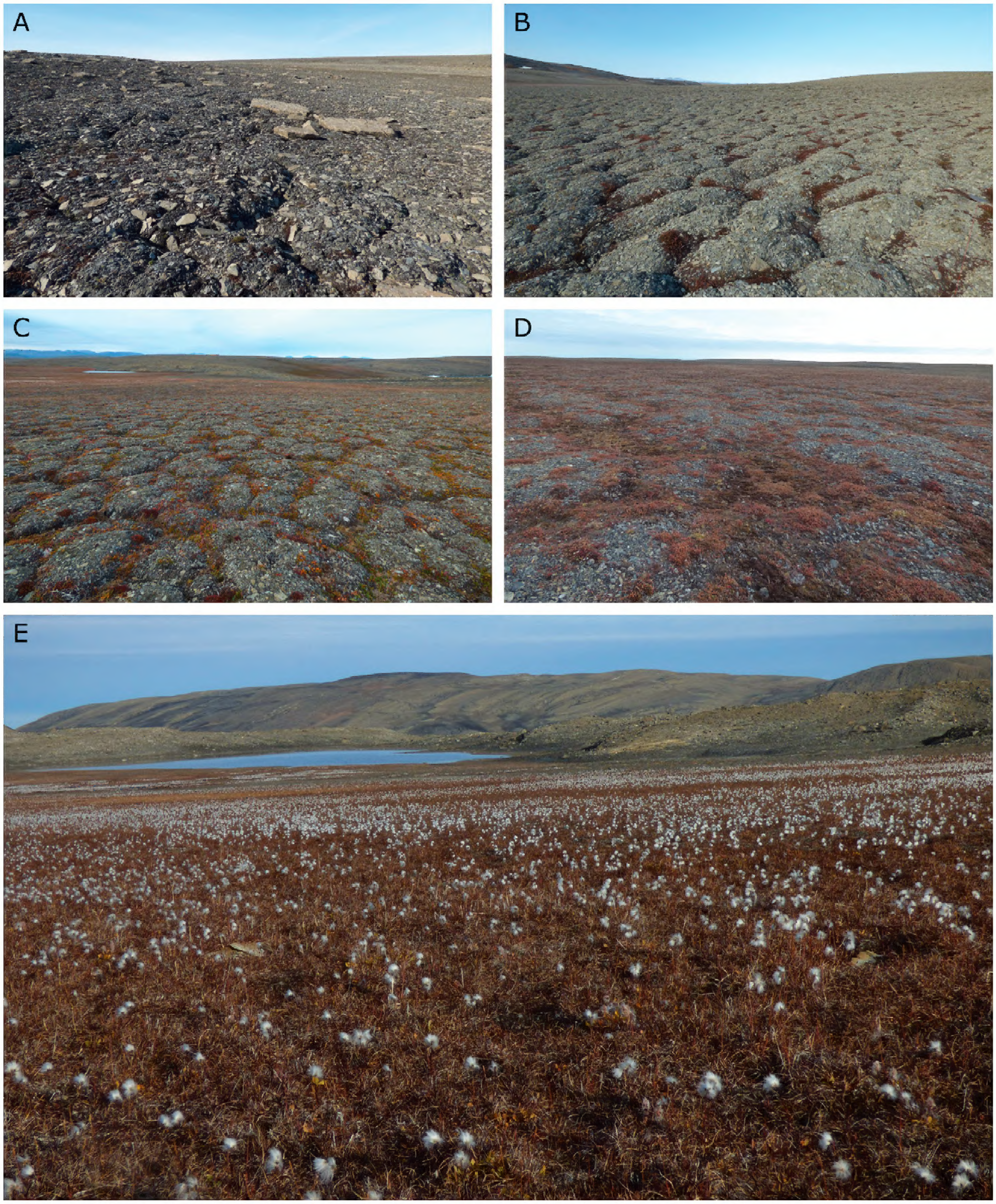

Figure 2. General appearance of the habitat types sampled. **A.** Barren ground. **B.** Xeric. **C.** Xeric-mesic. **D.** Mesic. **E.** Wetland. Photos A–E by Émilie Desjardins.

both survey methodologies. Overall, the most diverse family was Poaceae (18 spp.), followed by Brassicaceae (9 spp.), Caryophyllaceae (6 spp.), Saxifragaceae (6 spp.), Cyperaceae (4 spp.), Ranunculaceae (3 spp.), Equisetaceae (2 spp.), Juncaceae (2 spp.), Polygonaceae (2 spp.), and Rosaceae (2 spp.). The families Asteraceae, Orobanchaceae, Papaveraceae, and Salicaceae were each represented by a single species. Only two species, *Dryas integrifolia* Vahl subsp. *integrifolia* and *Salix arctica* Pallas, are dwarf shrubs. Among the 58 recorded species, one is listed by NatureServe as imperiled in Nunavut (*Festuca viviparoidea* Krajina ex Pavlick subsp. *viviparoidea*), and 15 are endemic to the Canadian Arctic ecozone, including an intergeneric hybrid species (×*Puccinellia vacillans* (T. Fries) Tzvelev; Table 1).

In Table 1, we present the species found during our two field seasons and indicate if each taxon was recorded by previous collecting expeditions. Occurrences from

Table 1. List of species found in the study area (Alert, Ellesmere Island, Nunavut, Canada) based on 2018–2019 inventory, including specimens accession numbers at the Louis-Marie Herbarium (QFA) (Québec City, Québec, Canada) and Canadian Museum of Nature Herbarium (CAN) (Ottawa, Ontario, Canada). Previous literature records for each taxon from Bruggemann and Calder (1953) and occurrences recorded by other collectors found in GBIF (2020) are also indicated, along with the main habitat, and the proposed status by IUCN Red List of Threatened Species (2020) and NatureServe (2020). Names are based on VASCAN (Brouillet et al. 2010+; Desmet and Brouillet 2013), while synonyms used in Saarela et al. 2020 and Elven et al. 2011 are also indicated. A star symbol (*) following a name indicates an Arctic endemic species (Daniëls et al. 2020). Habitat: B = barren ground, X = xeric, M = mesic, W = wetland. IUCN status: NA = not available, LC = least concern. NatureServe status: NA = not available, NSR = no status rank, S = secure, AS = apparently secure, H = hybrid, I = imperiled. The NatureServe status is indicated separately for Canada (Can) and Nunavut (Nu) when they differ.

Species	Voucher(s) 2018–2019	Previous records	Habitat	IUCN status	NatureServe status
Asteraceae					
Taraxacum phymatocarpum J. Vahl	*Desjardins et al. s.n.* (QFA0634995)	Johnson 1950 Gadbois and Laverdière 1952 Bruggemann and Calder 1953 Harington 1959	X	NA	NSR
Brassicaceae					
Braya purpurascens (R. Brown) Bunge ex Ledebour Syn.: *Braya glabella* Richardson subsp. *purpurascens* (R. Brown) Cody	*Desjardins et al. s.n.* (QFA0635558, QFA0635559, QFA0635560)	Johnson 1950 Bruggemann and Calder 1953 Harington 1959	X	LC	AS (Can) NSR (Nu)
Braya thorild-wulffii Ostenfeld subsp. *thorild-wulffii**	*Desjardins et al. s.n.* (QFA0635557 [CAN], QFA0635589)	Johnson 1950 MacDonald 1951	X	NA	NSR
Cardamine bellidifolia Linnaeus	*Desjardins et al. s.n.* (QFA0635556)	Bruggemann and Calder 1953 Harington 1959	W	NA	S (Can) NSR (Nu)
Cochlearia groenlandica Linnaeus	*Desjardins et al. s.n.* (QFA0635554, QFA0635555, QFA0635584)	MacDonald 1951 Bruggemann and Calder 1953 Harington 1959	W	LC	S (Can) NSR (Nu)
Draba corymbosa R. Brown ex de Candolle	*Desjardins et al. s.n.* (QFA0635552 [CAN], QFA0635553 [CAN], QFA0635584)	Johnson 1950 MacDonald 1951 Harington 1959	X	NA	NSR
Draba lactea Adams	*Desjardins et al. s.n.* (QFA0635551 [CAN])	Bruggemann and Calder 1953	W	NA	S (Can) NSR (Nu)
Draba micropetala Hooker*	*Desjardins et al. s.n.* (QFA0635549, QFA0635586 [CAN])	Johnson 1950 Harington 1959	X	NA	AS (Can) NSR (Nu)
Draba pauciflora R. Brown*	*Desjardins et al. s.n.* (QFA0635550 [CAN])		M	NA	AS (Can) NSR (Nu)
Draba subcapitata Simmons	*Desjardins et al. s.n.* (QFA0635585 [CAN])	Johnson 1950 Bruggemann and Calder 1953 Harington 1959	W	NA	AS (Can) NSR (Nu)
Caryophyllaceae					
Cerastium arcticum Lange*	*Desjardins et al. s.n.* (QFA0635574)	Johnson 1950 MacDonald 1951 Harington 1959 Pilon 1975	X	NA	NA
Cerastium regelii Ostenfeld	*Desjardins et al. s.n.* (QFA0635520, QFA0635576)	Bruggemann and Calder 1953 Harington 1959	W	NA	AS (Can) NSR (Nu)
Sabulina rossii (R. Brown ex Richardson) Dillenberger & Kadereit*	*Desjardins et al. s.n.* (QFA0635571)	Bruggemann and Calder 1953	W	NA	S (Can) NSR (Nu)
Sabulina rubella (Wahlenberg) Dillenberger & Kadereit	*Desjardins et al. s.n.* (QFA0635573)	Bruggemann and Calder 1953 Johnson 1950 Harington 1959	X	NA	S (Can) NSR (Nu)
Silene uralensis (Ruprecht) Bocquet subsp. *uralensis** Syn.: *Silene uralensis* subsp. *arctica* (Fr.) Bocquet	*Desjardins et al. s.n.* (QFA0635570)	Johnson 1950 Bruggemann and Calder 1953 Harington 1959	W	NA	NSR
Stellaria longipes Goldie subsp. *longipes*	*Desjardins et al. s.n.* (QFA0635575)	Johnson 1950 MacDonald 1951 Bruggemann and Calder 1953 Harington 1959	M	NA	S (Can) NSR (Nu)
Cyperaceae					
Carex aquatilis Wahlenberg var. *minor* Boott Syn.: *Carex aquatilis* subsp. *stans* (Drejer) Hultén	*Desjardins et al. s.n.* (QFA0635568, QFA0635569)	Gadbois and Laverdière 1952 Bruggemann and Calder 1953	W	LC	NSR
Carex fuliginosa Schkuhr Syn.: *Carex fuliginosa* subsp. *misandra* (R. Br.) Nyman	*Desjardins et al. s.n.* (QFA0635566, QFA0635567)	Bruggemann and Calder 1953	W	NA	NSR
Eriophorum triste (Th. Fries) Hadac & Á. Löve	*Desjardins et al. s.n.* (QFA0635565)	MacDonald 1951 Bruggemann and Calder 1953 Harington 1959	W	LC	S
Eriophorum scheuchzeri Hoppe subsp. *arcticum* Novoselova	*Desjardins et al. s.n.* (QFA0635564)	Gadbois and Laverdière 1952 Bruggemann and Calder 1953	W	LC	NSR
Equisetaceae					
Equisetum arvense Linnaeus Syn.: *Equisetum arvense* subsp. *alpestre* (Wahlenb.) Schönswetter & Elven	*Desjardins et al. s.n.* (QFA0634994)	MacDonald 1951 Bruggemann and Calder 1953	W	LC	S
Equisetum variegatum Schleicher ex F. Weber & D. Mohr subsp. *variegatum*	*Desjardins et al. s.n.* (QFA0634993)	Bruggemann and Calder 1953 Harington 1959	W	LC	S

Species	Voucher(s) 2018–2019	Previous records	Habitat	IUCN status	NatureServe status
Juncaceae					
Juncus biglumis Linnaeus	*Desjardins et al. s.n.* (QFA0635561, QFA0635562)	MacDonald 1951 Bruggemann and Calder 1953 Harington 1959	W	LC	S
Luzula nivalis (Laestadius) Sprengel	*Desjardins et al. s.n.* (QFA0635563)	MacDonald 1951 Bruggemann and Calder 1953 Harington 1959	W	LC	S
Orobanchaceae					
Pedicularis hirsuta Linnaeus	*Desjardins et al. s.n.* (QFA0635577)	Bruggemann and Calder 1953 Harington 1959	W	NA	S (Can) NSR (Nu)
Papaveraceae					
Papaver dahlianum Nordhagen	*Desjardins et al. s.n.* (QFA0634992)	MacDonald 1951 Johnson 1950 Harington 1959	X	NA	AS (Can) NSR (Nu)
Poaceae					
Alopecurus magellanicus Lamarck Syn.: *Alopecurus borealis* Trinuis	*Desjardins et al. s.n.* (QFA0635548)	Johnson 1950 MacDonald 1951 Bruggemann and Calder 1953 Harington 1959	W	LC	S
Arctagrostis latifolia (R. Brown) Grisebach subsp. *latifolia*	*Desjardins et al. s.n.* (QFA0635519, QFA0635547)	Bruggemann and Calder 1953 Harington 1959	W	LC	S
Deschampsia cespitosa (Linnaeus) Palisot de Beauvois subsp. *septentrionalis* Chiapella Syn.: *Deschampsia brevifolia* R. Brown	*Desjardins et al. s.n.* (QFA0635545, QFA0635546)	Bruggemann and Calder 1953	W	NA	S (Can) AS (Nu)
Festuca baffinensis Polunin	*Desjardins et al. s.n.* (QFA0635544)	Bruggemann and Calder 1953 Harington 1959	M	NA	S
Festuca brachyphylla Schultes & Schultes f. subsp. *brachyphylla*	*Desjardins et al. s.n.* (QFA0635541)	Bruggemann and Calder 1953 Harington 1959	W	NA	S
Festuca edlundiae S.G. Aiken, Consaul, & Lefkovitch*	*Desjardins et al. s.n.* (QFA0635542, QFA0635543)		M	NA	AS
Festuca hyperborea Holmen ex Frederiksen*	*Desjardins et al. s.n.* (QFA0635522)		M	NA	AS
Festuca viviparoidea Krajina ex Pavlick subsp. *viviparoidea*	*Desjardins et al. s.n.* (QFA0635517, QFA0635540, QFA0635587)	Harington 1959	M	NA	NSR (Can) I (Nu)
Phippsia algida (Solander) R. Brown	*Desjardins et al. s.n.* (QFA0635538, QFA0635539)	Bruggemann and Calder 1953	W	LC	S (Can) AS (Nu)
Pleuropogon sabinei R. Brown*	*Desjardins et al. s.n.* (QFA0635537)	Bruggemann and Calder 1953 MacDonald 1951	W	LC	AS
Poa abbreviata R. Brown subsp. *abbreviata*	*Desjardins et al. s.n.* (QFA0635535, QFA0635536)	Bruggemann and Calder 1953 Harington 1959 Johnson 1950	X	NA	S
Poa arctica R. Brown subsp. *arctica*	*Desjardins et al. s.n.* (QFA0635534)	Bruggemann and Calder 1953 Harington 1959	W	NA	S (Can) NSR (Nu)
Poa pratensis Linnaeus subsp. *colpodea* (Th. Fries) Tzvelev*	*Desjardins et al. s.n.* (QFA0635518, QFA0635533)	Harington 1959	M	LC	AS (Can) NSR (Nu)
Puccinellia angustata (R. Brown) E.L. Rand & Redfield*	*Desjardins et al. s.n.* (QFA0635529, QFA0635530)	Johnson 1950 Bruggemann and Calder 1953 Harington 1959	M	LC	AS
Puccinellia bruggemannii T.J. Sørensen*	*Desjardins et al. s.n.* (QFA0635526, QFA0635527, QFA0635528)	Johnson 1950	M	NA	AS
Puccinellia phryganodes (Trinius) Scribner & Merrill subsp. *neoarctica* (Á. Löve & D. Löve) Elven	*Desjardins et al. s.n.* (QFA0635525)	Bruggemann and Calder 1953	B	LC	S (Can) NSR (Nu)
Puccinellia vahliana (Liebmann) Scribner & Merrill*	*Desjardins et al. s.n.* (QFA0635523, QFA0635524, QFA0635531, QFA0635532)	Bruggemann and Calder 1953 Harington 1959	M	NA	AS
×*Pucciphippsia vacillans* (T. Fries) Tzvelev*	*Desjardins et al. s.n.* (QFA0635516 [CAN], QFA0635588)		W	NA	NSR (Can) H (Nu)
Polygonaceae					
Bistorta vivipara (Linnaeus) Delarbre	*Desjardins et al. s.n.* (QFA0635578)	Johnson 1950 MacDonald 1951 Bruggemann and Calder 1953	W	NA	S (Can) NSR (Nu)
Oxyria digyna (Linnaeus) Hill	*Desjardins et al. s.n.* (QFA0635579)	Johnson 1950 MacDonald 1951 Bruggemann and Calder 1953	M	NA	S (Can) NSR (Nu)
Ranunculaceae					
Ranunculus hyperboreus Rottbøll Syn.: *Ranunculus hyperboreus* subsp. *hyperboreus*	*Desjardins et al. s.n.* (QFA0634991)	Bruggemann and Calder 1953 Harington 1959	W	LC	S (Can) NSR (Nu)
Ranunculus sabinei R. Brown*	*Desjardins et al. s.n.* (QFA0634990)	MacDonald 1951 Bruggemann and Calder 1953 Harington 1959	W	NA	AS (Can) NSR (Nu)
Ranunculus sulphureus Solander	*Desjardins et al. s.n.* (QFA0634989)	MacDonald 1951 Bruggemann and Calder 1953 Harington 1959	W	NA	S (Can) NSR (Nu)

Species	Voucher(s) 2018–2019	Previous records	Habitat	IUCN status	NatureServe status
Rosaceae					
Dryas integrifolia Vahl subsp. *integrifolia*	*Desjardins et al. s.n.* (QFA0635001)	MacDonald 1951 Bruggemann and Calder 1953 Pilon 1975	W	NA	S (Can) NSR (Nu)
Potentilla pulchella R. Brown	*Desjardins et al. s.n.* (QFA0635000)	MacDonald 1951 Bruggemann and Calder 1953 Harington 1959	M	NA	AS (Can) NSR (Nu)
Salicaceae					
Salix arctica Pallas	*Desjardins et al. s.n.* (QFA0635521)	Johnson 1950 Bruggemann and Calder 1953 MacDonald 1951	W	NA	S (Can) NSR (Nu)
Saxifragaceae					
Micranthes tenuis (Wahlenberg) Small	*Desjardins et al. s.n.* (QFA0634988)	MacDonald 1951 Bruggemann and Calder 1953 Harington 1959	W	NA	S (Can) NSR (Nu)
Saxifraga cernua Linnaeus	*Desjardins et al. s.n.* (QFA0635006)	Johnson 1950 Bruggemann and Calder 1953 Harington 1959	W	NA	S (Can) NSR (Nu)
Saxifraga cespitosa Linnaeus	*Desjardins et al. s.n.* (QFA0635005)	Johnson 1950 Bruggemann and Calder 1953	M	NA	S (Can) NSR (Nu)
Saxifraga flagellaris Willdenow subsp. *platysepala* (Trautvetter) A.E. Porsild	*Desjardins et al. s.n.* (QFA0635003)	Johnson 1950 MacDonald 1951 Bruggemann and Calder 1953 Harington 1959 Pilon 1975 Drew 1976 Pomerleau 1983	W	NA	NSR
Saxifraga oppositifolia Linnaeus subsp. *oppositifolia*	*Desjardins et al. s.n.* (QFA0635002)	MacDonald 1951 Bruggemann and Calder 1953 Harington 1959 Pilon 1975	X	NA	S (Can) NSR (Nu)
Saxifraga tricuspidata Rottbøll	*Desjardins et al. s.n.* (QFA0635004)	Bruggemann and Calder 1953	M	NA	S (Can) NSR (Nu)

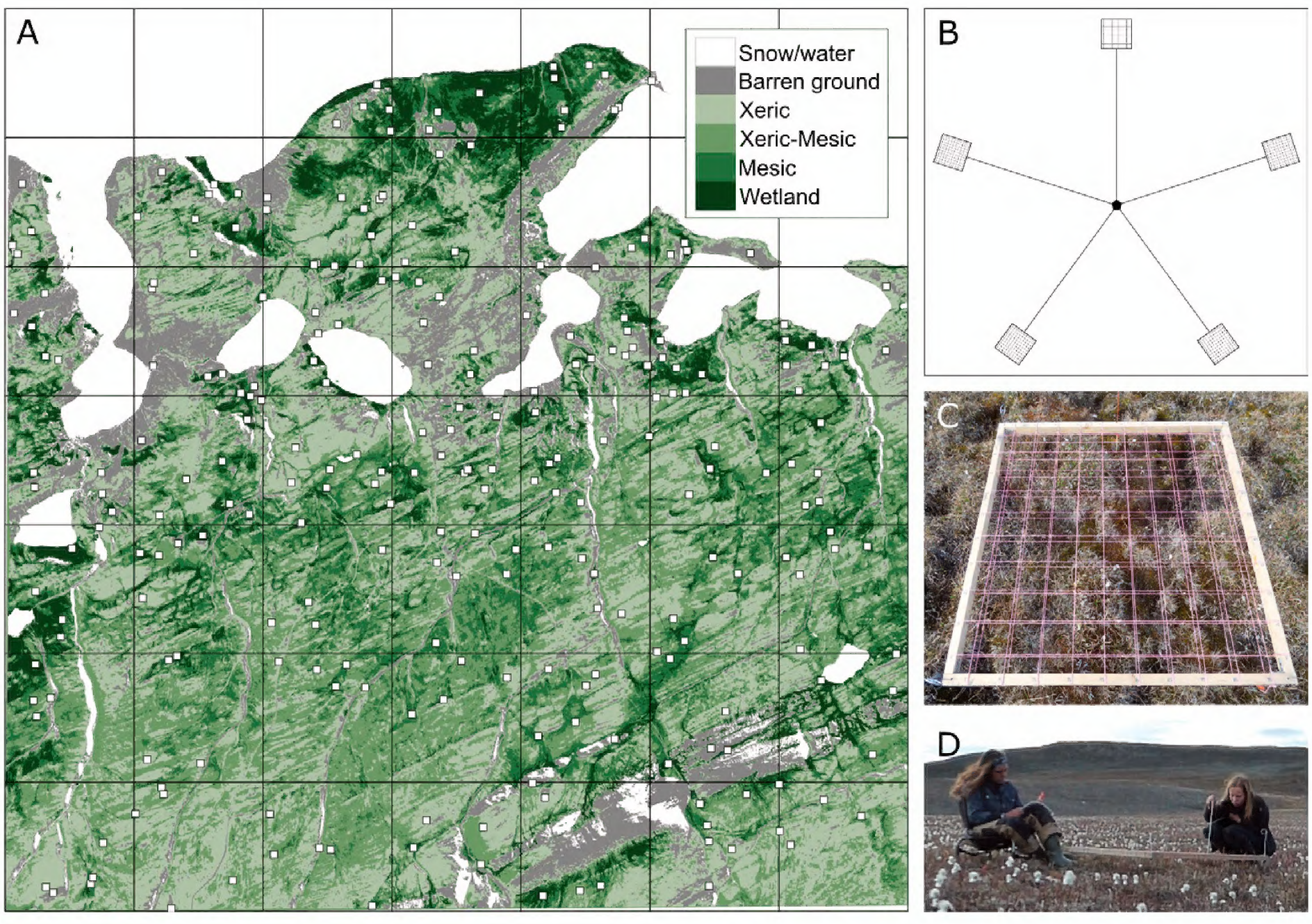

Figure 3. Systematic survey. **A.** Habitat map of the study area overlapped by 2 × 2 km grid showing locations of 264 vegetation plots (white squares) randomly distributed in five habitat types: barren ground, xeric, xeric-mesic, mesic, and wetland. **B.** Set up of the vegetation plot with the five 1m^2 quadrats. **C.** Top view of a quadrat. **D.** Vegetation sampling by an observer (right) helped by a scribe (left).

previous expeditions were compiled and reported as they appear in the Global Biodiversity Information Facility database (GBIF 2020) and were not revised by us. Additional collection data recorded during the 2018–2019 inventory are available in Supplementary Data 1. In the Identification subsections, we describe all species found in our 2018–2019 inventory and we compare collected specimens with similar or related species. Taxa are listed alphabetically by family and then by species.

Asteraceae – Daisy family

Taraxacum phymatocarpum J. Vahl

Figure 4

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°27′48″N, 062°47′33″W; 14 m a.s.l.; 8 Jul. 2019; habitat: river delta, with silty sand and rocks as substrates; QFA0634995.

Identification. Plants 2.5–5.5 cm high; herbaceous; not caespitose. Taproots present. Stems 1.5–4.0 cm long; ascending or erect; glabrous. Leaves basal; horizontal or patent; alternate; petiolate. Petioles 2–7 mm long; winged; glabrous. Leaf blades 5–25 mm long, 1–6 mm wide; oblanceolate; unlobed or dentate, with 1–3 triangular, acute lobes on each side; dark green; abaxial and adaxial surfaces both glabrous; margins glabrous; apices obtuse or acute. Calyculi 1.5–5.0 mm long; appressed or spreading; ovate; dark green or dark purple; surface glabrous; apices acute. Phyllaries 7–15 mm long; appressed; lanceolate; dark green or dark purple; surface glabrous. Inflorescence a solitary capitulum; 13–20 mm wide; with 30–40 zygomorphic florets. Sepals represented by pappi; 4–7 mm long; pale yellow or white. Petals 5; fused; pale yellow. Ray floret limbs 6–12 mm long, 1–4 mm wide; ligulate. Androecium with 5 stamens and 3–5 mm long anther tubes. Gynoecium with 1 style and 2 stigmas. Fruit an achene.

Taraxacum phymatocarpum can be differentiated from the three other *Taraxacum* F.H. Wiggers species present on Ellesmere Island (*T. ceratophorum* (Ledebour) de Candolle, *T. holmenianum* Sahlin, and *T. hyparcticum* Dahlstedt; Aiken et al. 2007; GBIF 2020) by the following: plant height <10 cm; flowering head small (15–20 mm wide); petals yellow without pink-grey stripes (as in *T. hyparcticum*); and ligulate floret limbs ≤9 mm wide (Brouillet 2006; Aiken et al. 2007).

Brassicaceae – Draba family

Braya purpurascens (R. Brown) Bunge ex Ledebour

Syn.: *Braya glabella* Richardson subsp. *purpurascens* (R. Brown) Cody

Figure 5A

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°28′11″N, 062°41′60″W; 154 m a.s.l.; 14 Aug. 2019; habitat: xeric, with polygonal patterned ground made of till and rocks, and sparse dominance of *Saxifraga oppositifolia* Linnaeus; QFA0635558

Figure 4. *Taraxacum phymatocarpum* J. Vahl habit. Photo by Émilie Desjardins.

• same locality; 82°29′46″N, 062°44′07″W; 30 m a.s.l.; 4 Jul. 2019; habitat: barren ground in a slope, with till and rocks as substrates, and sparse dominance of *Saxifraga oppositifolia*; QFA0635559 • same locality; 82°27′48″N, 062°47′33″W; 14 m a.s.l.; 8 Jul. 2019; habitat: river delta, with silty sand and rocks as substrates; QFA0635560.

Identification. Plants 1.5–4.5 cm high; herbaceous; caespitose. Taproots present. Stems 0.5–4.0 cm long; erect, ascending, or decumbent; hairy, with simple and branched hairs (2 rays: Y, T, and V). Leaves basal; alternate; petiolate. Petioles 2–5 mm long; winged; margins ciliate, with simple hairs. Leaf blades 4–19 mm long, 0.8–2.7 mm wide; linear or oblanceolate; unlobed or lobed, with 1–2 triangular acute lobes on each side; bases attenuate; abaxial and adaxial surfaces both shiny (living specimens) and glabrous; margins ciliate, with simple hairs; apices acute or obtuse. Inflorescence a corymbiform raceme, with 2–6 flowers; not elongating or slightly elongating as the fruit matures. Pedicels glabrous or sparsely hairy. Sepals 4; 1.7–2.9 mm long, 0.8–1.9 mm wide; ovate or oblong; purple; surface glabrous; margins glabrous or ciliate, with simple hairs; apices rounded. Petals 4; 2.4–3.8 mm long, 0.8–1.6 mm wide; obovate or obtrullate; unlobed; white and purple-tinged proximally. Androecium with 6 stamens and 0.3–0.5 mm long anthers. Gynoecium with 1 style and 1 stigma. Fruit a silique; 5.0–10.2 mm long, 1.5–3.0 mm wide; elliptic or oblanceolate; cylindrical; yellowish purple or greyish green; surface glabrous or sparsely hairy, with simple and branched hairs (2 rays: T and V). Styles are persisting in fruit 0.7–1.2 mm long, 0.2–0.4 mm wide. Stigmas 0.5–0.7 mm wide; larger than the styles.

Braya Sternberg & Hoppe species can be differentiated from white-flowered *Draba* Linnaeus species by the

terete or ovoid fruits; ciliate sepal margins; and presence of simple and 2-forked hairs on the leaves (Aiken et al. 2007; Saarela et al. 2020). Among the four *Braya* species present on Ellesmere Island (GBIF 2020), *B. purpurascens*, *B. thorild-wulffii* Ostenfeld subsp. *thorild-wulffii*, and *B. glabella* subsp. *glabella* and subsp. *prostrata* J.G. Harris have one or no cauline leaf and ovoid to cylindrical-elliptic fruits, whereas *B. humilis* (C.A. Meyer) B.L. Robinson subsp. *humilis* and subsp. *ellesmerensis* J.G. Harris have more than one cauline leaf and linear fruits (Aiken et al. 2007; Harris 2010; Saarela et al. 2020). *B. thorild-wulffii* subsp. *thorild-wulffii* and *B. glabella* subsp. *prostrata* have decumbent to prostrate stems, whereas *B. purpurascens* and *B. glabella* subsp. *glabella* have erect or ascending stems (Harris 2006, 2010). *B. thorild-wulffii* subsp. *thorild-wulffii* has short styles persisting in fruits (0–1 mm long), whereas *B. purpurascens* and both *B. glabella* subspecies have mostly longer styles (0.3–2.0 mm long; Harris 2006, 2010). The fruits of *B. purpurascens* and both *B. glabella* subspecies are oblong, ovoid-elliptic, or cylindrical-lanceolate, whereas they are ovoid or globose in *B. thorild-wulffii* subsp. *thorild-wulffii* (Harris 2006; Saarela et al. 2020). Fruits of *B. glabella* subsp. *glabella* are oblong or narrowly oblong-lanceoloid, often curved, and 3.5–8.3 times as long as wide, whereas they are ovoid-elliptic or oblong-elliptic, usually straight, and 2.5–3.7 times as long as wide in *B. purpurascens* and *B. glabella* subsp. *prostrata* (Harris 2010).

Braya thorild-wulffii Ostenfeld subsp. *thorild-wulffii*

Figure 5B

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°27′20″N, 062°03′05″W; 142 m a.s.l.; 26 Jul. 2019; habitat: xeric with polygonal patterned ground made of till and rocks, and sparse dominance of *Puccinellia bruggemannii* T.J. Sørensen and *Stellaria longipes* Goldie; QFA0635557, CAN • same locality; 82°29′09″N, 062°00′03″W; 36 m a.s.l.; 30 Jul. 2019; habitat: mesic in a slope, with hummocks made of till and rocks, dominated by *Stellaria longipes* and moss; QFA0635589.

Identification. Plants 1.5–6.0 cm high; herbaceous; caespitose. Taproots present. Stems 1.0–5.5 cm long; decumbent or prostrate; hairy, with simple hairs. Leaves basal; alternate; petiolate. Petioles 2–4 mm long; winged; margins glabrous or ciliate, with simple hairs. Leaf blades 3–10 mm long, 1.1–2.5 mm wide; oblanceolate or obtrullate; bases attenuate; abaxial surface sparsely hairy, with simple hairs; adaxial surface glabrous; margins ciliate, with simple hairs; apices obtuse. Inflorescence a raceme, with 2–4 flowers; elongating as the fruit matures. Pedicels hairy. Sepals 4; 2.0–2.6 mm long, 1.1–1.5 mm wide; ovate or oblong; green or purple; surface hairy, with simple hairs; margins ciliate; apices obtuse. Petals 4; 1.3–3.4 mm long, 0.8–1.6 mm wide; obovate; unlobed; white. Androecium with 6 stamens and 0.2–0.4 mm long anthers. Gynoecium with 1 style and 1 stigma. Fruit a silique; 4–10 mm long, 2.1–3.7 mm wide; ovoid or spherical; purple or green; hairy, with simple hairs. Styles persisting in fruit 0.05–0.10 mm long, 0.3–0.7 mm wide. Stigmas 0.4–0.8 mm wide; slightly larger than the styles.

Characteristics allowing to distinguish *B. thorild-wulffii* subsp. *thorild-wulffii* from the other *Braya* species on Ellesmere Island can be found under *B. purpurascens*.

Cardamine bellidifolia Linnaeus

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°25′52″N, 062°07′49″W; 296 m a.s.l.; 16 Jul. 2019; habitat: wetland in a mountain pass, with peat and rocks as substrates, dominated by moss and *Saxifraga cernua* Linnaeus; QFA0635556.

Identification. Plants 1.5–4.0 cm high; herbaceous; caespitose. Taproots present. Stems 1–3 cm long; erect or ascending; glabrous. Leaves basal and cauline; isomorphic; alternate; petiolate. Petioles 5–9 mm long; not winged; glabrous. Leaf blades 3–6 mm long, 1.5–4.2 mm wide; ovate; bases cuneate or obtuse; abaxial and adaxial surfaces both glabrous; margins glabrous; apices rounded or obtuse. Inflorescence a raceme, with 2–4 flowers; not elongating or slightly elongating as the fruit matures. Pedicels glabrous. Sepals 4; 1.8–2.2 mm long, 0.7–1.2 mm wide; ovate or oblong; green or purple, with hyaline margins; surface glabrous; margins glabrous; apices rounded or obtuse. Petals 4; 2.6–3.8 mm long, 0.8–1.4 mm wide; obovate; unlobed; not clawed; white. Androecium with 6 stamens and 0.4–0.5 mm long anthers. Gynoecium with 1 style and 1 stigma. Fruit a silique; 7–16 mm long, 0.6–1.1 mm wide; elongate-linear or elongate-elliptic; flattened; dark purple; glabrous. Styles persisting in fruit 0.6–1.4 mm long, 0.4–0.5 mm wide. Stigmas 0.4–0.5 mm wide; as wide as the styles.

Cardamine bellidifolia differs from *Cardamine polemonioides* Rouy, also present on Ellesmere Island (Aiken et al. 2007), by having simple cauline leaves when present (in contrast to compound, 7–21 foliolate, or -pinnatisect cauline leaves; Al-Shehbaz et al. 2010a; Saarela et al. 2020), and ≤7 mm long, not clawed petals (in contrast to 9.0–12.3 mm long, clawed petals; Saarela et al. 2020).

Cochlearia groenlandica Linnaeus

Figure 5C

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°29′56″N, 062°19′19″W; 48 m a.s.l.; 8 Aug. 2019; habitat: xeric near the sewage outlet, with till and rocks as substrates, and sparse dominance of *Puccinellia angustata* (R. Brown) E.L. Rand & Redfield and *Cochlearia groenlandica*; QFA0635554 • same locality; 82°31′13″N, 062°25′46″W; 44 m a.s.l.; 27 Jul. 2019; habitat: mesic, with polygonal patterned ground made of till, dominated by *Alopecurus magellanicus*

Figure 5. Brassicaceae. **A.** *Braya purpurascens* (R. Brown) Bunge ex Ledebour habit. **B.** *Braya thorild-wulffii* Ostenfeld subsp. *thorild-wulffii* habit **C.** *Cochlearia groenlandica* Linnaeus habit. **D.** *Draba corymbosa* R. Brown ex de Candolle sepals and open flowers, and **E.** habit. **F.** *Draba subcapitata* Simmons fruit-forming. Photos A by Jacob Caron Carrier, B, D, E, F by Émilie Desjardins, and C by Charline Couchoux.

Lamarck and *Saxifraga oppositifolia*; QFA0635555.

Identification. Plants 2.5–6.0 cm high; herbaceous; caespitose. Taproots present. Stems 1.0–4.5 cm long; erect, ascending, or decumbent; glabrous. Leaves basal and cauline; heterophyllous; alternate; long-petiolate (basal leaves), short-petiolate (lower cauline leaves), and sessile (upper cauline leaves). Basal leaf petioles 8–13 mm long; not winged; glabrous. Basal leaf blades 4–6 mm long, 5–7 mm wide; ovate or deltate; bases truncate or subcordate; abaxial and adaxial surfaces both glabrous; margins glabrous; apices rounded or obtuse. Cauline leaf

blades 3.6–9.0 mm long, 1.2–2.9 mm wide; oblanceolate; unlobed or lobed, with 1–2 triangular acute lobes on each side; bases cuneate. Inflorescence a raceme, with 5–12 flowers; elongating as the fruit matures. Pedicels glabrous. Sepals 4; 0.8–1.8 mm long, 0.4–0.8 mm wide; ovate or oblong; pale brown or purple, with hyaline margins; surface glabrous; margins glabrous; apices rounded or obtuse. Petals 4; 1.1–2.4 mm long, 0.2–1.0 mm wide; obovate; unlobed; white and sometimes pinkish tinged. Androecium with 6 stamens and 0.2–0.3 mm long anthers. Gynoecium with 1 style and 1 stigma. Fruit a silique; 3.7–5.9 mm long, 2.2–3.2 mm wide; spherical or ovoid; yellowish green or greyish purple; glabrous. Styles persisting in fruit 0.2–0.4 mm long, 0.1–0.2 mm wide. Stigmas 0.2–0.4 mm wide; larger than the styles.

***Draba corymbosa* R. Brown ex de Candolle**
Figure 5D, E

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°26′22″N, 062°50′39″W; 201 m a.s.l.; 7 Aug. 2019; habitat: barren ground in a slope, with till and rocks as substrates; QFA0635552, CAN • same locality; 82°31′03″N, 062°26′21″W; 57 m a.s.l.; 26 Jun. 2019; habitat: barren ground, with polygonal patterned ground made of till and rocks, and sparse dominance of *Saxifraga oppositifolia* and *Poa abbreviata* R. Brown; QFA0635553, CAN • same locality; 82°31′35″N, 062°18′19″W; 5 m a.s.l.; 3 Aug. 2019; habitat: wetland, with peat as substrate, dominated by *Salix arctica*, *Saxifraga oppositifolia*, and moss; QFA0635584.

Identification. Plants 2–4 cm high; herbaceous; caespitose. Taproots and rhizomes present. Stems 1.0–3.5 cm long; erect or ascending; hairy, with simple and branched hairs (2–5 rays: T, V, Y, cruciform, ternate, and dendritic). Leaves basal; alternate or whorled; petiolate or subsessile. Petioles 2–5 mm long; winged; margins ciliate, with simple hairs. Leaf blades 3–12 mm long, 1.4–3.8 mm wide; obtrullate or oblanceolate; bases attenuate; abaxial and adaxial surfaces both moderately to densely hairy, with simple and branched hairs (2–5 rays: Y, V, ternate, and dendritic); margins ciliate, with simple hairs; apices obtuse. Inflorescence a corymbose raceme, with 2–4 flowers; not elongating as the fruit matures or slightly elongating as the fruit matures. Pedicels 1.5–6.0 mm long; hairy. Sepals 4; 2.4–3.5 mm long, 1.1–2.1 mm wide; ovate; green or yellow, with yellow margins; surface hairy, with simple and few branched hairs (2 rays: Y and V); margins glabrous; apices obtuse or acute. Petals 4; 3.8–5.3 mm long; 2.0–2.9 mm wide; obovate; slightly lobed or undulating; yellow. Androecium with 6 stamens and 0.4–0.6 mm long anthers. Gynoecium with 1 style and 1 stigma. Fruit a silique; 4–11 mm long, 2.3–4.4 mm wide; ovate or lanceolate; flattened; green or purple; hairy, with simple and branched hairs (2 rays: Y, V, and T). Styles persisting in fruits 0.4–0.7 mm long, 0.2–0.4 mm wide. Stigmas 0.5–0.9 mm wide; distinctly larger than the styles.

Among the yellow-flowered *Draba* species present on Ellesmere Island (*D. alpina* Linnaeus, *D. arctogena* (E. Ekman) E. Ekman, *D. micropetala* Hooker, *D. oblongata* R. Brown ex de Candolle, and *D. pauciflora*; Aiken et al. 2007; GBIF 2020), *D. corymbosa* and *D. simmonsii* Elven & Al-Shebaz are characterized by larger petals (2–4 mm wide; Aiken et al. 2007; Elven and Al-Shehbaz 2008; Garneau and Sabourin 2018). *D. corymbosa* also has wider fruits (3.1–5.5 mm wide) and longer styles persisting in fruits (0.4–1.0 mm long) compared to *D. alpina*, *D. micropetala*, and *D. simmonsii,* which have 1.9–3.8 mm wide fruits and 0.05–0.30 mm long styles (Elven and Al-Shehbaz 2008; Al-Shehbaz et al. 2010b; Garneau and Sabourin 2018). *D. corymbosa* has mainly branched hairs on the abaxial leaf surface, whereas the other yellow-flowered *Draba* species have simple or simple and branched hairs (Al-Shehbaz and Mulligan 2013; Saarela et al. 2020).

***Draba lactea* Adams**

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°28′14″N, 062°51′41″W; 61 m a.s.l.; 10 Jul. 2019; habitat: wetland in a mountain pass, with peat and till as substrates, dominated by *Eriophorum triste* (Th. Fries) Hadac & Á. Löve and moss; QFA0635551, CAN.

Identification. Plants 3.0–5.5 cm high; herbaceous; caespitose. Taproots present. Stems 2.0–4.5 cm long; erect; glabrous or hairy, with sparse branched hairs (2–8 rays: Y and dendritic). Leaves basal and sometimes 1 cauline; alternate or whorled; petiolate or subsessile. Petioles 2–3 mm long; slightly winged; margins glabrous or ciliate, with simple hairs. Basal leaf blades 4.1–9.0 mm long, 0.9–2.4 mm wide; oblanceolate; bases attenuate; abaxial surface sparsely hairy, with branched hairs (2–6 rays: Y, ternate, and dendritic); adaxial surface glabrous; margins ciliate with erect or deflexed, simple hairs and branched hairs (2–4 rays: Y and dendritic); apices acute or obtuse. Inflorescence a raceme, with 2–3 flowers; slightly elongating as the fruit matures. Pedicels 1.5–4.5 mm long; glabrous. Sepals 4; 1.3–2.6 mm long, 1.0–1.6 mm wide; ovate or oblong; green or purple, with hyaline margins; surface glabrous or hairy, with a few sparse simple hairs apically; margins glabrous; apices obtuse. Petals 4; 3.1–3.9 mm, long; 1.7–2.2 mm wide; obovate; unlobed or undulating; white. Androecium with 6 stamens and 0.4–0.6 mm long anthers. Gynoecium with 1 style and 1 stigma. Fruit a silique; 1.6–4.5 mm long, 1.3–2.7 mm wide; ovate; flattened; green or purple; glabrous. Styles persisting in fruit 0.2–0.7 mm long, 0.1–0.3 mm wide. Stigmas 0.3–0.5 mm wide; larger than the styles.

In addition to *Draba lactea*, five other white-flowered *Draba* species are present on Ellesmere Island (*D. arctica* J. Vahl, *D. cinerea* Adams, *D. fladnizensis* Wulfén, *D. nivalis* Liljeblad, and *D. subcapitata* Simmons; Aiken et al. 2007; GBIF 2020). *D. lactea* can be differentiated by having mainly glabrous pedicels and sepals (in contrast to *D. arctica*, *D. cinerea*, *D. nivalis*, and *D. subcapitata*),

and glabrous fruits (in contrast to *D. arctica*, *D. cinerea*, and *D. subcapitata*; Aiken et al. 2007; Garneau and Sabourin 2018). Glabrous pedicels and fruits are unique to *D. fladnizensis* and *D. lactea*, but they differ in few characters: *D. lactea* has branched hairs (2–12 rays) rather than simple and 2-forked hairs seen in *D. fladnizensis* (Al-Shehbaz et al. 2010b); *D. lactea* has bigger petals (3–5 mm long, 1.8–3.0 mm wide) than *D. fladnizensis* (2.0–2.5 mm long, 0.8–1.5 mm wide; Al-Shehbaz and Mulligan 2013; Saarela et al. 2020); and margin leaf hairs of *D. fladnizensis* are straight and pointing strongly forward in contrast to *D. lactea* whose simple hairs can be deflexed and not strongly directed forward (Svalbard Flora 2020).

Draba micropetala Hooker

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°25′52″N, 062°07′49″W; 296 m a.s.l.; 16 Jul. 2019; habitat: wetland in a mountain pass, with peat and rocks as substrates, dominated by moss and *Saxifraga cernua*; QFA0635549 • same locality; 82°26′34″N, 062°19′06″W; 178 m a.s.l.; 13 Aug. 2019; habitat: barren ground on a river bed, with rocks as substrate; QFA0635586, CAN.

Identification. Plants 2.0–4.5 cm high; herbaceous; caespitose. Taproots present. Stems 1.0–3.5 cm long; erect or ascending; hairy, with simple and branched hairs (2–5 rays: T, Y, cruciform, ternate, and dendritic). Leaves basal; alternate or whorled; petiolate or subsessile. Petioles 1–4 mm long; winged; margins ciliate, with simple hairs. Basal leaf blades 5.7–8.0 mm long, 2.1–3.9 mm wide; obovate or oblanceolate; bases attenuate; abaxial surface moderately or densely hairy, with simple and branched hairs (2–4 rays: Y, ternate, cruciform, and dendritic); adaxial surface glabrous or sparsely hairy, with simple and branched hairs (2–3 rays: Y, and ternate); margins ciliate, with simple and branched hairs (2 rays: Y); apices obtuse. Inflorescence a raceme, with 2–4 flowers; elongating or not elongating as the fruit matures. Pedicels 1.0–4.5 mm long; hairy. Sepals 4; 2.1–2.4 mm long, 0.8–1.0 mm wide; obovate or oblong; green and purple-tinged, with yellow margins; surface hairy, with simple and branched hairs (2–3 rays: Y and ternate); margins glabrous; apices obtuse or acute. Petals 4; 2.8–3.7 mm, long; 0.8–1.4 mm wide; oblanceolate; slightly lobed or undulating; pale yellow. Androecium with 6 stamens and 0.3–0.5 mm long anthers. Gynoecium with 1 style and 1 stigma. Fruit a silique; 4.0–9.9 mm long, 2.7–3.5 mm wide; oblanceolate or obovate; flattened; green; hairy, with simple hairs and branched hairs (2 rays: Y). Styles persisting in fruit 0.05–0.20 mm long, 0.3–0.5 mm wide. Stigma 0.3–0.5 mm wide; as wide as, or slightly larger than, the styles.

Draba micropetala and *D. pauciflora* both have narrow petals (≤2 mm wide) compared to all the other yellow-flowered *Draba* species on Ellesmere Island (*D. alpina*, *D. arctogena*, *D. oblongata*, and *D. simmonsii*; Aiken et al. 2007; Al-Shehbaz et al. 2010b; GBIF 2020). In addition, pedicels are usually shorter (1–4 mm long) in *D. micropetala* than in *D. alpina* and *D. simmonsii*, which have 2.5–30.0 mm long pedicels (Al-Shehbaz et al. 2010b). *D. micropetala* and *D. pauciflora* can usually be distinguished on other characters: *D. micropetala* has leaves with an obtuse to rounded apex, whereas *D. pauciflora* has leaves with an acute apex; the leaves of *D. micropetala* have a predominance of cruciform hairs on the leaves, whereas those of *D. pauciflora* have a simple and forked hairs; and *D. micropetala* has ovate-elliptic, 2.0–3.2 mm wide fruits, whereas *D. pauciflora* has obovate, 3–5 mm wide fruits (Elven and Al-Shehbaz 2008; Saarela et al. 2020). The difference in the fruits did not fit exactly with our specimens from Alert. Instead, we found mainly obovate or oblanceolate, 2.7–3.5 mm wide fruits in *D. micropetala*, and lanceolate or elliptic, 1.8–4.0 mm wide fruits in *D. pauciflora*. However, based on the specimens from Alert, we found that using the dimensions of the styles and stigmas persisting on the fruits were good additional criteria to differentiate the two species; *D. micropetala* had shorter styles (0.05–0.20 mm long) with stigmas as wide as the styles (or very slightly wider), whereas *D. pauciflora* had longer styles (0.2–0.4 mm long) with stigmas always wider than the styles. As for the other yellow-flowered *Draba* found at Alert, *D. corymbosa*, it had even longer styles (0.4–0.7 mm long) and the stigmas were even more distinctly wider than the styles (the two structures appearing like a T).

Draba pauciflora R. Brown

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°29′58″N, 062°33′36″W; 66 m a.s.l.; 11 Aug. 2019; habitat: mesic, with polygonal patterned ground made of till, dominated by *Stellaria longipes*; QFA0635550, CAN.

Identification. Plants 1.7–3.5 cm high; herbaceous; caespitose. Taproots present. Stems 0.4–3.0 cm long; erect or ascending; hairy, with simple and branched hairs (2–3 rays: T, V, Y, and ternate). Leaves basal; alternate or whorled; petiolate or subsessile. Petioles 2–5 mm long; winged; margins glabrous or ciliate, with simple hairs. Basal leaf blades 5.2–9.0 mm long, 1.8–3.4 mm wide; oblanceolate or obtrullate; bases attenuate; abaxial surface moderately hairy, with simple and branched hairs (2–5 rays: Y, T, ternate, and dendritic); adaxial surface sparsely to moderately hairy, with simple and branched hairs (2 rays: Y); margins ciliate, with simple long hairs; apices acute. Inflorescence a raceme, with 2–5 flowers; elongating or not elongating as the fruit matures. Pedicels 1.5–4.0 mm long; hairy. Sepals 4; 2.3–2.5 mm long, 0.8–0.9 mm wide; ovate or oblong; yellow, with hyaline margins; surface hairy, with simple and branched hairs (2 rays: Y); margins glabrous; apices obtuse. Petals 4; 2.9–4.0 mm long, 1.2–1.8 mm wide; obovate or oblanceolate; unlobed, slightly lobed, or undulating; white or pale yellow. Androecium with 6 stamens and 0.2–0.4 mm long anthers. Gynoecium with 1 style and 1 stigma. Fruit a silique; 5.5–10.0 mm long, 1.8–4.0 mm wide; lanceolate or

elliptic; flattened; green; hairy, with simple and branched hairs (2 rays: Y, T, and V). Styles persisting in fruit 0.2–0.4 mm long, 0.3–0.5 mm wide. Stigmas 0.4–0.7 mm wide; larger than the styles.

Characteristics allowing to distinguish *D. pauciflora* from the other yellow-flowered *Draba* species present on Ellesmere Island can be found under *D. corymbosa* and *D. micropetala*.

***Draba subcapitata* Simmons**

Figure 5F

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°28′51″N, 062°10′58″W; 86 m a.s.l.; 15 Aug. 2019; habitat: xeric, with till and rocks as substrate, and sparse dominance of *Saxifraga oppositifolia*; QFA0635585, CAN.

Identification. Plants 1–2 cm high; herbaceous; caespitose. Taproots present. Stems 0.5–1.5 cm long; erect or ascending; hairy, with simple and branched hairs (2–4 rays: T, V, and dendritic). Leaves basal; alternate or whorled; petiolate or subsessile. Petioles 1.0–1.5 mm long; slightly winged; margins glabrous or ciliate, with simple hairs. Basal leaf blades 3.7–5.0 mm long, 1–2 mm wide; linear or narrowly obtrullate; bases attenuate; midvein prominent; abaxial surface glabrous or sparsely hairy, with simple and branched hairs (2 rays: Y and T); adaxial surface glabrous; margins slightly revolute and ciliate, with simple long hairs; apices acute or obtuse. Inflorescence a raceme, with 2 or 3 flowers; not or slightly elongating as the fruit matures. Pedicels 1–2 mm long; hairy. Sepals 4; 1.2–1.6 mm long, 0.7–0.8 mm wide; ovate or oblong; green or purple, with hyaline margins; surface hairy, with simple hairs; margins glabrous; apices obtuse. Petals 4; 1.3–2.2 mm, long; 0.8–1.1 mm wide; obovate; unlobed, slightly lobed, or undulating; white. Androecium with 6 stamens and 0.3–0.4 mm long anthers. Gynoecium with 1 style and 1 stigma. Fruit a silique; 3–5 mm long, 2.0–2.3 mm wide; ovate or elliptic; slightly bulged; dark purple; glabrous or sparsely hairy, with simple hairs. Styles persisting in fruit 0.05–0.30 mm long, 0.2–0.3 mm wide. Stigmas 0.2–0.3 mm wide; as wide as the styles.

Draba subcapitata differs from the five other white-flowered *Draba* species present on Ellesmere Island (Aiken et al. 2007; GBIF 2020) by having smaller petals (≤2.5 mm long and ≤1.0 mm wide; in contrast to *D. arctica*, *D. cinerea*, *D. fladnizensis*, *D. lactea*, *D. nivalis*; Aiken et al. 2007), and by the combination of predominantly simple and branched hairs (2–4 rays) on leaves and stems (in contrast to the presence of hairs with >4 rays in *D. arctica*, *D. lactea*, and *D. nivalis*; Garneau and Sabourin 2018).

Caryophyllaceae – Pink family

Cerastium arcticum Lange

Figure 6A

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°25′52″N, 062°07′49″W; 296 m a.s.l.; 16 Jul. 2019; habitat: wetland in a mountain pass, with peat and rocks as substrates, dominated by moss and *Saxifraga cernua*; QFA0635574.

Identification. Plants 1–12 cm high; herbaceous; caespitose. Taproots and rhizomes present. Stems 2–12 cm long; prostrate, or ascending; hairy, with septate glandular hairs and septate non-glandular hairs. Leaves basal and cauline; opposite; subsessile (basal and lower cauline leaves) or sessile (upper cauline leaves). Basal leaf blades 5–12 mm long, 2–5 mm wide; elliptic, lanceolate, obovate, or oblanceolate; abaxial and adaxial surfaces both hairy, with septate glandular hairs and septate non-glandular hairs (hairs 1.0–3.4 mm long); margins ciliate; apices acute, acuminate, or obtuse. Cauline leaf blades 1.7–3.6 mm long, 0.5–1.2 mm wide; abaxial and adaxial surface both hairy; margins hyaline and ciliate. Inflorescence a solitary flower or a dichasium, with 2–4 flowers. Bracts 4–9 mm long, 0.8–2.0 mm wide; surface hairy; margins hyaline (0.1–0.2 mm wide) and ciliate. Pedicels hairy. Sepals 5; 5.0–7.8 mm long, 1–3 mm wide; elliptic or lanceolate; green to purple; hairy, with septate glandular hairs and septate non-glandular hairs; margins hyaline and glabrous; apices acute. Petals 5; 6.0–9.8 mm long, 2.7–4.0 mm wide; obtriangular or oblanceolate; notched; white. Androecium with 10 stamens and 0.9–1.5 mm long, yellow anthers. Gynoecium with 5 styles and 1 stigma per style. Fruit a capsule; 9–11 mm long, 3–5 mm wide; cylindrical; straw-colored; ending with 8–10 teeth; glabrous.

Cerastium Linnaeus species can be differentiated from *Arenaria* Linnaeus and *Stellaria* Linnaeus species by the petals: *Cerastium* species have petals cleft at most to 25 %, whereas *Arenaria* species have unlobed petals and *Stellaria* species have petals cleft nearly to the base (Aiken et al. 2007). *C. arcticum* is very similar to *C. alpinum* Linnaeus subsp. *alpinum* and subsp. *lanatum* (Lamarck) Cesati, *C. beeringianum* Chamisso & Schlechtendal, and *C. bialynickii* Tolmatchew that are present on Ellesmere Island (GBIF 2020), but a few characters help differentiate them. *C. arcticum* has leaves with hairs that are always >0.3 mm long, whereas both *C. alpinum* subspecies have long but also short hairs (<0.3 mm long); bracts have more distinct hyaline margins in both *C. alpinum* subspecies (0.3–0.8 mm wide) than in *C. arcticum* (≤0.3 mm wide; Blondeau 2015a). As for the differences between *C. beeringianum* and *C. arcticum*, hairs on leaves are longer in *C. arcticum* (≥0.9 mm long) than in *C. beeringianum* (≤0.9 mm long); bract leaves of *C. arcticum* (4–9 mm long) are longer than those of *C. beeringianum* (2.5–3.0 mm long); and fruits of *C. arcticum* are also larger (3–5 mm wide) than those of *C. beeringianum* (2–3 mm wide; Aiken et al. 2007; Blondeau 2015a). *C. bialynickii* has a pulvinate growth form with short stems (1–10 cm long), whereas *C. arcticum*, both *C. alpinum* subspecies, and *C. beeringianum* have rhizomatous or mat-forming, not pulvinate growth form (cushion-like) with longer stems (5–50 cm long; Morton 2005).

Figure 6. Caryophyllaceae. **A.** *Cerastium arcticum* Lange habit. **B.** *Cerastium regelii* Ostenfeld habit and **C.** leaves. **D.** *Sabulina rubella* (Wahlenberg) Dillenberger & Kadereit habit. **E.** *Silene uralensis* (Ruprecht) Bocquet subsp. *uralensis* habit. **F.** *Stellaria longipes* Goldie subsp. *longipes* habit and **G.** leaves. Photos A, C, D, E, F by Émilie Desjardins, B by Jacob Caron Carrier, and G by Sandra Lai.

The stem length of the specimens of *C. arcticum* from Alert ranges from 2 to 12 cm and some specimens had a cushion growth form rather than a mat-forming growth form, and therefore do not exactly match the criteria above. Although, *C. bialynickii* is considered a synonym of *C. beeringianum* in Aiken et al. (2007), it is treated as a distinct species in FNA (Flora of North America Editorial Committee 2005), Tropicos (2020), and VASCAN (Brouillet et al. 2010+; Desmet and Brouillet 2013).

Cerastium regelii Ostenfeld

Figure 6B, C

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°29′09″N, 062°00′03″W; 36 m a.s.l.; 30 Jul. 2019; habitat: mesic in a slope, with hummocks made of till and rocks, dominated by *Stellaria longipes* and moss; QFA0635520 • same locality; 82°26′48″N, 062°26′12″W; 178 m a.s.l.; 28 Jul. 2019; habitat: wetland, with peat and rocks as substrates, dominated by *Alopecurus magellanicus* and moss; QFA0635576.

Identification. Plants 1–5 cm high; herbaceous; caespitose. Taproots and rhizomes present. Stems 1–4 cm long; prostrate, decumbent, or ascending; hairy, with septate non-glandular hairs. Axillary branches present. Leaves basal and cauline; isomorphic; opposite; petiolate (basal leaves) or sessile (cauline leaves). Petiole 1.4–2.0 mm

long; hairy. Basal leaf blades 3–6 mm long, 1.8–3.0 mm wide; elliptic or ovate; abaxial and adaxial surfaces both glabrous; margins glabrous or ciliate, with septate non-glandular hairs; apices obtuse. Cauline leaf blades 2.8–4.8 long, 0.5–1.7 mm; abaxial and adaxial surfaces both glabrous; margins ciliate, with septate non-glandular hairs; apices obtuse. Inflorescence a solitary flower or a dichasium with 2 flowers. Bracts 2–4 mm long, 1–2 mm wide; surface hairy; margins hyaline (≤0.1 mm wide) and ciliate. Pedicels hairy. Sepals 5; 4–5 mm long, 1–3 mm wide; lanceolate or elliptic; green and purple-tinged, with hyaline margins; surface hairy, with septate non-glandular hairs and spetate-glandular hairs; margins ciliate; apices acute. Petals 5; 5.1–8.0 mm long, 2.3–5.0 mm wide; obtriangular, oblanceolate, or obovate; notched; white. Androecium with 7–10 stamens and 0.6–1.2 mm long, pale yellow anthers. Gynoecium with 5 styles and 1 stigma per style. Fruit a capsule; 8.0–10.4 mm long, 2–3 mm wide; cylindrical; straw-colored; ending with 8–10 teeth; glabrous.

Cerastium regelii differs from *C. alpinum*, *C. arcticum*, *C. beeringianum*, and *C. bialynickii* by having shiny, glabrous leaf surfaces, whereas the four latter species have dull, densely hairy leaves (Aiken et al. 2007).

***Sabulina rossii* (R. Brown ex Richardson) Dillenberger & Kadereit**

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°27′34″N, 062°44′57″W; 118 m a.s.l.; 16 Aug. 2019; habitat: xeric, with polygonal patterned ground made of till and rocks, and sparse dominance of *Juncus biglumis* Linnaeus and moss; QFA0635571.

Identification. Plants 1–3 cm high; herbaceous; caespitose. Taproots present. Stems 0.5–1.5 cm long; prostrate, decumbent, or ascending; glabrous. Leaves cauline; opposite; sessile. Leaf blades 2–3 mm long, 0.3–1.0 mm wide; elliptic or linear; upwardly curved; appearing single-veined or veins inconspicuous; green, dark purple, or dark red; abaxial and adaxial surfaces both glabrous; margins glabrous; apices obtuse. Inflorescence a solitary flower. Pedicels glabrous. Sepals 5; 1.0–2.8 mm long, 0.5–1.3 mm wide; ovate; purple; surface glabrous; margins glabrous; apices obtuse or acute. Petals 5; 2–3 mm long, 0.7–1.2 mm wide; oblong or obovate; unlobed; white. Androecium with 10 stamens and 0.4–0.5 mm long, yellow anthers. Gynoecium with 3 styles and 1 stigma per style.

The only two *Sabulina* Reichenbach species present on Ellesmere have been found in our survey (Aiken et al. 2007; GBIF 2020). They differ in a few characters: *S. rossii* has glabrous stems, whereas *S. rubella* has pubescent stems with glandular hairs (Blondeau et al. 2015b; Saarela et al. 2020), and *S. rossii* has single-veined (if vein apparent) leaf blades ,whereas *S. rubella* has three-veined leaf blades (Aiken et al. 2007).

***Sabulina rubella* (Wahlenberg) Dillenberger & Kadereit**

Figure 6D

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°26′22″N, 062°50′39″W; 201 m a.s.l.; 7 Aug. 2019; habitat: barren ground in a slope, with till and rocks as substrates; QFA0635573.

Identification. Plants 1.5–3.5 cm high; herbaceous; caespitose. Taproots present. Stems 0.8–2.5 cm long; prostrate, decumbent, or ascending; hairy, with glandular hairs. Leaves cauline; opposite; sessile. Leaf blades 3.0–5.7 mm long, 0.5–1.0 mm wide; lanceolate or linear; straight or acending; veins 3; green; abaxial and adaxial surfaces both glabrous; margins ciliate, with glandular hairs; apices acute or apiculate. Inflorescence a solitary flower. Pedicels hairy. Sepals 5; 2–3 mm long, 0.5–1.4 mm wide; lanceolate; purple or green, with hyaline margins; surface glabrous or hairy, with glandular hairs; margins glabrous; apices acute. Petals 5; 2–3 mm long, 1.0–1.5 mm wide; oblanceolate or obovate; unlobed; white. Androecium with 10 stamens and 0.2–0.3 mm long, yellow anthers. Gynoecium with 3 styles and 1 stigma per style. Fruit a capsule; 2.8–3.0 mm long, 1.4–1.6 mm wide; ovoid or conical; straw-colored; glabrous.

Characteristics allowing to distinguish *S. rubella* from the other *Sabulina* species present on Ellesmere Island can be found under *S. rossii*.

Silene uralensis* (Ruprecht) Bocquet subsp. *uralensis

Syn.: *Silene uralensis* subsp. *arctica* (Fr.) Bocquet

Figure 6E

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°28′35″N, 062°28′23″W; 117 m a.s.l.; 15 Jul. 2019; habitat: xeric on a plateau between two creeks, with till and rocks as substrates; QFA0635570.

Identification. Plants 3–5 cm high; herbaceous; not caespitose. Taproots present. Stems 1.5–3.5 cm long; erect; hairy, with septate non-glandular hairs. Leaves basal and cauline; opposite; petiolate (basal and lower cauline leaves) or sessile (upper cauline leaves). Petioles 3–5 mm long; glabrous. Basal leaf blades 5–11 mm long, 1–3 mm wide; obtrullate or oblanceolate; green or purple; abaxial and adaxial surfaces both glabrous; margins ciliate, with sparse hyaline, septate non-glandular hairs; apices acute. Cauline leaf blades 6–9 mm long, 1–2 mm wide; abaxial and adaxial surfaces both sparsely hairy, with septate non-glandular hairs; margins ciliates; apices acute. Inflorescence a solitary flower. Bracts 3–4 mm long, 0.8–2.0 mm wide. Pedicels hairy. Sepals 5; fused. Calyx bell-shaped; 9–15 mm long, 7–11 mm wide; 5-lobed; hyaline, whitish purple or pink, with dark purple longitudinal ribs; hairy, with septate non-glandular hairs. Petals 5; same length or slightly longer than the calyx (emerging of 1.2–2.5 mm long from the calyx); oblanceolate; notched; pinkish purple. Androecium with 8–10 stamens and 0.6–0.8 mm long, greenish-yellow anthers. Gynoecium with 5 styles and 1 stigma per style.

Silene uralensis subsp. *uralensis* differs from the three other *Silene* species present on Ellesmere Island (*S. acaulis* (Linnaeus) Jacquin, *S. involucrata* (Chamisso & Schlechtendal) Bocquet subsp. *involucrata* and subsp. *tenella* (Tolmachew) Bocquet, and *S. sorensenis* (B. Boivin) Bocquet; Aiken et al. 2007; GBIF 2020) by having petals of the same length as the calyx or slightly longer; the others have petals largely exceeding the calyx (Aiken et al. 2007).

Stellaria longipes Goldie subsp. *longipes*

Figure 6F, G

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°29′59″N, 062°27′56″W; 82 m a.s.l.; 27 Jul. 2019; habitat: xeric in a slope, with polygonal patterned ground made of till and rocks, and sparse dominance of *Saxifraga oppositifolia*; QFA0635575.

Identification. Plants 1–8 cm high; herbaceous; caespitose. Taproots and thin rhizomes present. Stems 2–8 cm long; prostrate, decumbent, or erect; glabrous. Axillary branches present. Leaves cauline; opposite; sessile. Cauline leaf blades 4–9 mm long, 1.1–3.0 mm wide; lanceolate; appearing single-veined (midrib prominent); abaxial surface keeled; abaxial and adaxial surfaces both glabrous; margins glabrous; apices acute or acuminate. Inflorescence a solitary flower or a dichasium, with 2 flowers. Bracts 2.2–7.0 mm long, 0.6–2.0 mm wide. Pedicels glabrous. Sepals 5; 2–4 mm long, 1.0–1.5 mm wide; lanceolate; green, with hyaline margins; surface; margins ciliate; apices acute. Petals 5; 3–5 mm long, 3–4 mm wide; obovate or obtriangular; deeply cleft; white. Androecium with 8–10 stamens and 0.6–0.8 mm long, red anthers. Gynoecium with 3 styles and 1 stigma per style.

The deeply cleft petals distinguish *Stellaria* species from the other Caryophyllaceae genus (Aiken et al. 2007). *S. longipes* subsp. *longipes* can be differentiated from the two other *Stellaria* species on present on Ellesmere Island (GBIF 2020) by the following: *S. longipes* has red anthers, whereas *S. humifusa* Rottbøll and *S. crassifolia* Ehrhart have yellow anthers (Aiken et al. 2007); and *S. longipes* has strongly keeled leaf blades with midvein prominent, whereas *S. humifusa* and *S. crassifolia* have flat leaf blades with midvein obscure (Saarela et al. 2020).

Cyperaceae – Sedge family

Carex aquatilis Wahlenberg var. *minor* Boott

Syn.: *Carex aquatilis* subsp. *stans* (Drejer) Hultén

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°28′57″N, 062°38′31″W; 22 m a.s.l.; 5 Aug. 2019; habitat: wetland on the margins of a river delta, with peat as substrates, dominated by *Eriophorum triste* and moss; QFA0635568 • same locality; 82°30′08″N, 062°52′60″W; 91 m a.s.l.; 2 Aug. 2019; habitat: wetland in a mountain pass on the margins of a pond, with tussocks made of peat, dominated by *Eriophorum triste*; QFA0635569.

Identification. Plants 5–9 cm high; herbaceous; not caespitose. Fibrous roots and rhizomes present. Stems 2.5–11.0 cm long; erect, ascending, or decumbent; scabrous on angles. Leaves basal and cauline; alternate. Sheath margins glabrous. Ligules 0.6–2.0 mm long. Basal leaf blades 35–75 mm long, 1.8–4.0 mm wide; linear; flat or folded; abaxial and adaxial surfaces both glabrous; margins scabrous. Inflorescence a raceme, with 2–6 spikelets; 19–40 mm long. Bracts exceeding the inflorescence; 28–50 mm long. Lateral spikelets unisexual; pistillate; pedunculate; erect. Terminal spikelets unisexual; staminate; erect; pedunculate. Pistillate scales 1.1–2.8 mm long, 0.6–1.5 mm wide; ovate; purple or purplish brown, with midvein paler in color or pale green; apices acute. Staminate scales 2.0–2.8 mm long, 0.5–1.0 mm wide; oblanceolate; purple, with midvein paler in color; apices acuminate. Perigynium 1.1–2.5 mm long, 0.6–1.8 mm wide; ovate or obovate; flattened; green or pale brown proximally and purplish-brown apically; surface glabrous; margins glabrous; apices beaked. Androecium with 3 stamens and 1.8–2.8 mm long anthers. Gynoecium with 1 style and 2 stigmas.

Carex aquatilis var. *minor* differs from all other *Carex* Linnaeus species on Ellesmere Island by having the lower bract exceeding the inflorescence (Aiken et al. 2007).

Carex fuliginosa Schkuhr

Syn.: *Carex fuliginosa* subsp. *misandra* (R. Br.) Nyman

Figure 7A

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°30′25″N, 062°36′45″W; 24 m a.s.l.; 8 Aug. 2019; habitat: wetland on the margins of a small river, with peat and till as substrates, dominated by *Alopecurus magellanicus* and moss; QFA0635566 • same locality; 82°27′37″N, 062°51′53″W; 16 m a.s.l.; 20 Jul. 2019; habitat: wetland on the margins of a lake, with peat and till as substrates, dominated by moss, *Eriophorum scheuchzeri*, and *Eriophorum triste*; QFA0635567.

Identification. Plants 4–13 cm high; herbaceous; caespitose. Fibrous roots present. Stems 3.5–11.5 cm long; erect or ascending; glabrous. Leaves basal and cauline; alternate. Sheath margins scabrous. Ligule absent or inconspicuous. Basal leaf blades 20–45 mm long, 2–4 mm wide; linear; flat or folded; curled; abaxial and adaxial surfaces both glabrous; margins scabrous. Inflorescence a raceme, with 2–4 spikelets; 12–40 mm long. Bracts shorter than the inflorescence; 8–32 mm long. Lateral spikelets pistillate or sometimes gynecandrous; pedunculate; inclined or pendent. Terminal spikelets bisexual; gynecandrous; pedunculate; inclined. Pistillate scales 2.5–4.0 mm long, 0.8–1.5 mm wide; lanceolate; purplish brown, with hyaline margins or paler in color (sometimes midvein paler in color); apices acute or acuminate. Staminate scales 3.2–3.6 mm long, 0.8–1.3 mm wide; oblanceolate; pinkish purple or brownish purple, with hyaline margins; apices acute or acuminate. Perigynium 3.0–4.5

mm long, 0.7–1.4 mm wide; pyriform or lanceoloid; green or pale brown proximally and dark purple apically; surface glabrous; margins scabrous; apices beaked, bidentate. Androecium with 3 stamens and 1.8–2.4 mm long anthers. Gynoecium with 1 style and 3 stigmas.

Among the 12 *Carex* species present on Ellesmere Island with compound spikes (GBIF 2020), *Carex fuliginosa* can be differentiated by the following: pedunculate and mostly unisexual spikelets (in contrast to *C. marina* Dewey and *C. maritima* Gunnerus with only bisexual, sessile spikelets); terminal gynaecandrous spikelet (in contrast to terminal staminate spikelet in *C. atrofusca* Schkuhr, *C. capillaris* Linnaeus subsp. *fuscidula* (V.I. Kreczetovicz ex T.V. Egorova) Á. Löve & D. Löve, *C. glacialis* Mackenzie, and *C. membranacea* Hooker); 2.5–5.0 mm long pistillate scales (in contrast to *C. krausei* Boeckeler with 1.6–2.1 mm long pistillate scales); fused perigynum margins (in contrast to open perigynum margins in *C. simpliciuscula* Wahlenberg); and three stigmas (in contrast to two stigmas in *C. aquatilis* var. *minor*, *C. bigelowii* Torrey ex Schweinitz subsp. *bigelowii*, and *C. saxatilis* Linnaeus; Saarela et al. 2020).

***Eriophorum scheuchzeri* Hoppe subsp. *arcticum* Novoselova**

Figure 7B

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°27′37″N, 062°51′53″W; 16 m a.s.l.; 20 Jul. 2019; habitat: wetland on the margins of a lake, with peat and till as substrates, dominated by moss, *Eriophorum scheuchzeri*, and *Eriophorum triste*; QFA0635564.

Identification. Plants 8–13 cm high; herbaceous; not caespitose. Fibrous roots and rhizomes present. Stems 6.5–11.0 cm long; erect; glabrous. Leaves basal and cauline; alternate. Sheath margins glabrous. Ligules 0.5–3.1 mm long. Basal leaf blades 20–65 mm long, 0.5–2.0 mm wide; linear; folded; straight; abaxial and adaxial surfaces both glabrous; margins glabrous. Cauline bladeless leaves with sheaths brown apically and hyaline margins. Inflorescence a spike; 15–30 mm long. Bract absent. Spikelet spherical; bisexual, with both sexes in each floret; sessile. Proximal scales (4–6 empty scales proximally); 3.0–6.3 mm long, 1–4 mm wide; ovate or lanceolate; grey or black, with hyaline margins; apices acute. Perianth represented by bristles; bright white. Androecium with 3 stamens and 0.5–1.5 mm long anthers. Gynoecium with 1 style and 3 stigmas. Fruit an achene; 1.5–2.2 mm long, 0.6–0.9 mm wide; obovoid or lanceoloid; glabrous.

Four *Eriophorum* Linnaeus species are present on Ellesmere Island (GBIF 2020). Only *E. triste* and *E. angustifolium* Honckeny subsp. *angustifolium* have more than two spikelets, whereas *E. scheuchzeri* and *E. callitrix* Chamisso have a solitary spikelet (Saarela et al. 2020). *E. scheuchzeri* differs by having rhizomes and ≤7 empty proximal scales, whereas *E. callitrix* is caespitose (i.e., without rhizomes) and has usually ≥10 empty proximal scales (Saarela et al. 2020). In addition, two subspecies of *E. scheuchzeri* are found on Ellesmere Island (GBIF 2020) and can be differentiated according to the following characters: subsp. *arcticum* has spherical spikelets, whereas subsp. *scheuchzeri* has hemispherical spikelets; proximal fertile scales of subsp. *arcticum* are darker and gradually passing to paler grey tones with conspicuous hyaline margins, whereas proximal fertile scales of subsp. *scheuchzeri* are completely dark with dark margins or reduced, sharply differentiated hyaline margins (Saarela et al. 2020).

***Eriophorum triste* (Th. Fries) Hadac & Á. Löve**

Figure 7C, D

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°27′37″N, 062°51′53″W; 16 m a.s.l.; 20 Jul. 2019; habitat: wetland on the margins of a lake, with peat and till as substrates, dominated by moss, *Eriophorum scheuchzeri*, and *Eriophorum triste*; QFA0635565.

Identification. Plants 8–19 cm high; herbaceous; not caespitose. Fibrous roots and rhizomes present. Stems 7.0–16.5 cm long; erect; glabrous. Leaves basal and cauline; alternate. Sheath margins scabrous. Ligules 0.6–1.7 mm long. Basal leaf blades 30–90 mm long, 1.3–4.0 mm wide; linear; flat or folded; straight; abaxial surface scabrous; adaxial surface glabrous; margins scabrous. Inflorescence a raceme, with 2–4 spikelets; 15–30 mm long. Lower bracts shorter than the inflorescence; 13–24 mm long. Peduncles 5–18 mm long; scabrous all around the surface. Lateral spikelets and terminal spikelet bisexual, with both sexes in each floret; pedunculate; erect or pendent. Proximal scales 3.8–5.3 mm long, 2.0–3.1 mm wide; ovate or lanceolate; greyish black sometimes purple or red-tinged, with or without narrow, hyaline margins at the apex; apices acute or acuminate. Perianth represented by bristles; white or yellowish-brown. Androecium with 3 stamens and 1.9–3.8 mm long anthers. Gynoecium with 1 style and 3 stigmas. Fruit an achene; 2.0–2.4 mm long, 0.9–1.9 mm wide; obovoid; keeled; glabrous.

Eriophorum triste is similar to *E. angustifolium* subsp. *angustifolium* by having more than two spikelets, but can be differentiated by culms, peduncles, scale, and anther characters: *E. triste* has shorter culms (≤30 cm) than *E. angustifolium* (20–100 cm; Ball and Wujek 2002); *E. triste* has scabrous, arcuate, ≤2 cm peduncles, whereas *E. angustifolium* has glabrous (or scabrous on angles), drooping, ≤10 cm long peduncles (Ball and Wujek 2002; Saarela et al. 2020); *E. triste* has grey to black scales with or without hyaline margins, whereas *E. angustifolium* has brownish grey, greyish, reddish or ferruginous scales with broad hyaline margins (Ball and Wujek 2002; Saarela et al. 2020); anthers of *E. triste* are usually shorter (1.8–3.0 mm long) than those of *E. angustifolium* (2.5–5.0 mm long; Saarela et al. 2020); and fruits are obovoid, 2.0–2.5 mm long in *E. triste*, whereas they are oblong-obovoid or oblong-elliptical, 2.5–3.5 mm long

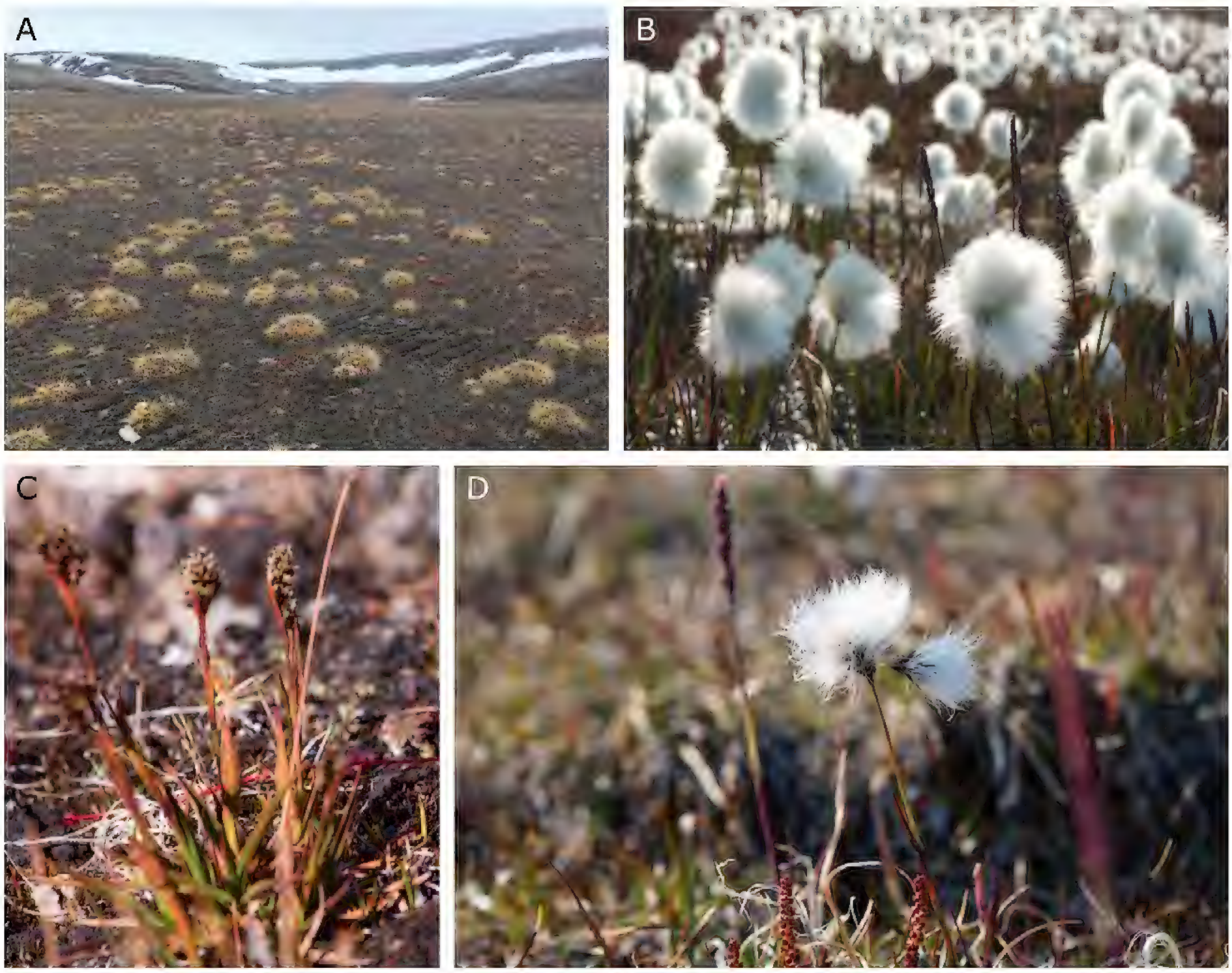

Figure 7. Cyperaceae. **A.** *Carex fuliginosa* Schkuhr habitat. **B.** *Eriophorum scheuchzeri* Hoppe subsp. *arcticum* Novoselova habit. **C.** *Eriophorum triste* (Th. Fries) Hadac & Á. Löve habit with young and **D.** mature inflorescences. Photos A by Émilie Desjardins, B, D by Francis Robitaille, and C by Audrey Le Pogam.

in *E. angustifolium* (Saarela et al. 2020). The culm height from the specimens of Alert (9–16 cm), as well as the peduncle length and scabrousity, and the fruit dimensions and shape correspond with those reported in the literature, but not the scale color and the anther length. The scales were not only grey to black, but some scales also had a reddish-purple tinge in the center. The anthers were also longer than the maximum anther length known in *E triste*. Only *E. triste* has previously been found at Alert and the surrounding areas (GBIF 2020).

Equisetaceae – Horsetail family

***Equisetum arvense* Linnaeus**

Syn.: *Equisetum arvense* subsp. *alpestre* (Wahlenb.) Schönswetter & Elven

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°28′22″N, 062°36′20″W; 78 m a.s.l.; 17 Jul. 2019; habitat: xeric on the margins of a river inside a creek; QFA0634994.

Identification. Plants 2–7 cm high; herbaceous; not caespitose. Fibrous roots and rhizomes present. Rhizomes black or reddish-brown. Vegetative stems 2–7 cm long; annual; ascending or decumbent; green or yellowish-green; simple or branched from the whorls (branches ascending). Leaves reduced to fused sheaths in whorls. Cauline sheaths 0.5–2.0 mm long; yellowish-green proximally and purplish-brown apically, and sometimes with hyaline margins; ending with 4–8 teeth. Cauline teeth lanceolate; apices acute. Rameal sheaths 0.3–0.8 mm long; attenuate; green and sometimes brown apically; ending with 3 or 4 teeth. Teeth triangular or lanceolate; apices acute. Sporiferous stems annual; erect; green or yellowish-green; simple. Strobilus 4.5 mm long, 2 mm wide.

Three *Equisetum* Linnaeus species are present on Ellesmere Island, although *E. pratense* Ehrhart has only been found once near Eureka (GBIF 2020). *Equisetum arvense* and *E. pratense* both have vegetative stems bearing whorls of branches, whereas the vegetative stems are unbranched in *E. variegatum* (Hauke 1993). *Equisetum arvense* has ascending branches with attenuate, rameal sheath teeth, whereas *E. pratense* has spreading branches with deltate, rameal sheath teeth (Hauke 1993).

Equisetum variegatum* Schleicher ex F. Weber & D. Mohr subsp. *variegatum

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°30′25″N, 062°36′45″W; 24 m a.s.l.;

8 Aug. 2019; habitat: wetland on the margins of a small river, with peat and till as substrates, dominated by *Alopecurus magellanicus* and moss; QFA0634993.

Identification. Plants 2–10 cm high; herbaceous; not caespitose. Fibrous roots and rhizomes present. Rhizomes black, purplish brown, or orange. Vegetative stems 2.5–9.0 cm long; evergreen; ascending or decumbent; green or yellowish-green; simple. Leaves reduced to fused sheaths in whorls. Cauline sheaths 1–3 mm long; green or yellowish-green proximally, with an apical broad black band, and white margins; ending with 4–8 teeth. Teeth triangular or lanceolate; apices acute or awned. Sporiferous stems not seen at Alert.

Characteristics allowing to distinguish *E. variegatum* from the other *Equisetum* species present on Ellesmere Island can be found under *E. arvense*.

Juncacea – Rush family

***Juncus biglumis* Linnaeus**

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°27′17″N, 062°35′55″W; 166 m a.s.l.; 11 Jul. 2019; habitat: mesic in a slope; QFA0635561 • same locality; 82°29′09″N, 062°00′03″W; 36 m a.s.l.; 30 Jul. 2019; habitat: mesic in a slope, with hummocks made of till and rocks, dominated by *Stellaria longipes* and moss; QFA0635562.

Identification. Plants 2–8 cm high; herbaceous; caespitose or not caespitose. Fibrous roots and short rhizomes present. Stems 1.0–7.5 cm long; erect; glabrous. Leaves basal. Sheaths hyaline or pale reddish-brown; margins glabrous. Basal leaf blades 16–40 mm long, 0.6–1.2 mm wide; linear; canaliculate or folded; green or purple; abaxial and adaxial surfaces both glabrous; margins glabrous; apices acuminate, sometime calloused, and black or dark purple. Inflorescence an anthela, with 1 or 2 flowers inserted on top of the other; 5.7–8.0 mm long. Bracts 5.0–8.7 mm long; exceeding the inflorescence; spathiform; green or reddish-purple; margins glabrous; apices acute and calloused. Bracteoles absent. Tepals 6; 2.1–3.9 mm long; 0.6–0.8 mm wide; lanceolate, oblong, or oblanceolate; purple; margins hyaline; apices obtuse. Androecium with 6 stamens and 0.5–0.8 mm long anthers. Gynoecium with 3 styles and 1 stigma per style. Fruit a capsule; 2.9–4.0 mm long, 1.3–1.9 mm wide; obvoid; trilocular; purple or reddish-brown, with dark purplish valve margins; glabrous.

Juncus biglumis can be separated from the three other *Juncus* Linnaeus species present on Ellesmere Island (Aiken et al. 2007; GBIF 2020) by the following characters: flowers of *J. biglumis* are side by side in a vertical plane, in contrast to *J. arcticus* Willdenow, *J. castaneus* Smith subsp. *leucochlamys* (W.J. Zinger ex V.I. Kreczetowicz) Hultén, and *J. triglumis* Linnaeus subsp. *albescens* (Lange) Hultén, which have flowers ordered side by side in a horizontal plane; and anthers of *J. biglumis* (0.4–0.7 mm long) are smaller than the other species (≥0.7 mm long in *J. arcticus*, *J. castaneus*, and *J. triglumis*; Aiken et al. 2007).

***Luzula nivalis* (Laestadius) Sprengel**

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°28′24″N, 062°14′38″W; 109 m a.s.l.; 18 Jul. 2019; habitat: mesic on the margins of a river active during spring snowmelt; QFA0635563.

Identification. Plants 4–14 cm high; herbaceous; caespitose or not caespitose. Fibrous roots and short rhizomes present. Stems 3.0–12.5 cm long; erect; glabrous. Leaves basal and cauline. Sheaths brown or straw-colored; margins glabrous. Basal leaf blades 18–55 mm long, 0.8–4.0 mm wide; linear; flat; green and pale orange; abaxial and adaxial surfaces both glabrous; margins hairy, with non-glandular hairs; apices mucronulate or acute, calloused, and dark purple. Cauline leaf blades 12–20 mm long, 0.6–1.5 mm wide; folded or involute. Inflorescence an anthela, with 1–4 glomerules and ≤60 flowers; 6–13 mm long. Bracts 4–12 mm long; not exceeding the inflorescence; lanceolate; red; margins glabrous; apices acute or acuminate. Bracteoles 2; 1.5–2.5 mm long. Tepals 6; 0.8–1.7 mm long, 0.6–0.8 mm wide; ovate; dark brown or dark purple; margins hyaline; apices acute or obtuse. Androecium with 6 stamens and 0.3–0.5 mm long anthers. Gynoecium with 3 styles and 1 stigma per style. Fruit a capsule; 1.9–2.5 mm long, 1.0–1.4 mm wide; ovoid; slightly flattened; green to dark purple; with a small beak; glabrous.

Luzula nivalis is similar to *L. confusa* Lindeberg, also present on Ellesmere Island, but the two differ in the following characters: *L. nivalis* has narrow, flat basal leaves (≤5 cm long, 2–4 mm wide), whereas *L. confusa* has larger, subcanaliculate to flat leaves (6–9 cm long, 1.5–2.5 mm wide; Saarela et al. 2020); *L. nivalis* has leaves with calloused tip but not *L. confusa* (Hay 2013); and *L. nivalis* has mucronulate leaf apices, whereas *L. confusa* has acuminate apices (Saarela et al. 2020).

Orobanchaceae – Broomrape family

***Pedicularis hirsuta* Linnaeus**

Figure 8

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°31′04″N, 062°28′48″W; 66 m a.s.l.; 27 Jul. 2019; habitat: mesic, with hummocks made of till, dominated by *Stellaria longipes*, *Saxifraga oppositifolia*, and moss; QFA0635577.

Identification. Plants 4–9 cm high; herbaceous; not caespitose. Taproots present. Stems 2–7 cm long; erect; hairy, with woolly hairs; with cataphylls. Leaves basal and cauline; heterophyllous; alternate; petiolate (basal and lower cauline leaves) or sessile (upper cauline leaves). Petioles 5–15 mm long; winged (basal leaves) or not winged (some cauline leaves); hairy, with floccose white hairs. Basal leaf blades 4–17 mm long, 3–5 mm wide; elongate-oblong; pinnatifid or pinnatisect, with 5–8 crenate lobes on each side; green to purple; abaxial and adaxial surfaces both sparsely to moderately hairy, with floccose hairs. Cauline leaf blades 3–7 mm long, 1–3 mm wide. Inflorescence a spiciform raceme, with 10–16 flowers.

Bracts floccose. Pedicels hairy. Flowers zygomorphic. Sepals 5; fused. Calyx tubular; 2.5–6.0 mm long, 2–4 mm wide; with 5 lobes apically; purple; surface hairy, with floccose hairs; margins ciliate; apices obtuse. Petals 5; fused; white and pink. Corolla bilabiate; 6–13 mm long with an inferior 2- or 3-lobed lip, and a superior narrow galeate lip. Galeate lip with 2 small teeth apically. Androecium with 4 stamens and 1.0–1.4 mm long anthers. Gynoecium with 1 style and 1 stigma. Stamens and stigma not protruding from the corolla tube.

Pedicularis hirsuta can be differentiated from the four other *Pedicularis* Linnaeus species present on Ellesmere Island (Aiken et al. 2007; GBIF 2020) by the following: leaves distributed along the stem (in contrast to mainly scapose stems in *P. sudetica* Willdenow subsp. *albolabiata* Hultén and subsp. *arctoeuropaea* Hultén; Aiken et al. 2007; Saarela et al. 2020); floccose hairs on stems and petioles (in contrast to glabrous stems and petioles in *P. sudetica*; Aiken et al. 2007); basal leaf blades with 5–11 lobes on each side (in contrast to 10–25 lobes in *P. lanata* Willdenow ex Chamisso & Schlechtendal subsp. *lanata* and *P. sudetica*; Aiken et al. 2007; Garneau 2018); pink, purple or white petals (in contrast to yellow petals present in *P. capitata* Adams; Aiken et al. 2007; Saarela et al. 2020); style hidden inside galea (in contrast to style protruding in *P. langsdorffii* Fischer ex Steven subsp. *arctica* (R. Brown) Pennell ex Hultén; Saarela et al. 2020); petal length ≤13 mm and anther length ≤1.5 mm (in contrast to all other *Pedicularis* species; Aiken et al. 2007). Hybrid individuals of *P. hirsuta* × *P. langsdorffii* subsp. *arctica* are reported from Lake Hazen, though they may resemble *P. hirsuta* in appearance, they can be distinguished by their variously extended styles (Sokoloff et al. 2015).

Figure 8. *Pedicularis hirsuta* Linnaeus habit. Photo by Audrey Le Pogam.

Papaveraceae – Poppy family

***Papaver dahlianum* Nordhagen**

Figure 9A, B

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°25′52″N, 062°07′49″W; 296 m a.s.l.; 16 Jul. 2019; habitat: wetland in a mountain pass, with peat and rocks as substrates, dominated by moss and *Saxifraga cernua*; QFA0634992.

Identification. Plants 2–13 cm high; herbaceous; caespitose. Taproots present. Stems 1–11 cm long; erect or ascending; hairy, with brown hairs. Leaves basal; alternate; petiolate. Petioles 5–30 mm long; flat; hairy, with pale brown hairs. Basal leaf blades 5–17 mm long, 2–10 mm wide; pinnatifid, with 1 terminal lobe and 2 or 3 main, ovate or oblong, acute lobes on each side (sometimes with secondary lobes); abaxial and adaxial surfaces both hairy, with dense white, yellow, or pale brown hairs; margins ciliate. Buds 10–12 mm long, 6–8 mm wide; less than twice as long as wide; ovoid; hairy, with dense dark brown hairs. Inflorescence a solitary flower. Sepals 2; 8–10 mm long, 4–6 mm wide; ovate; green or pinkish-brown; surface hairy, with dense dark brown hairs. Petals 4; 9–21 mm long, 12–22 mm wide; overlapping; obovate; unlobed; yellow or pale yellow (greenish-blue when withered); margins sometimes fringed. Androecium with 28–35 stamens and 0.9–1.0 mm long anthers. Gynoecium with 6 stigmatic rays. Fruit a capsule; 10 mm long, 7 mm wide; obpyriform (with its broadest part apically); slightly constricted just beneath the flat stigmatic disc; green; hairy, with dark brown hairs.

Papaver dahlianum can be differentiated from some Canadian Arctic *Papaver* Linnaeus species by the pinnatifid blades, in contrast to pinnatisect blades found in *P. labradoricum* (Fedde) Solstad & Elven, *P. lapponicum* (Tolmatchew) Nordhagen, and *P. hultenii* Knaben (Solstad and Elven, unpublished). *P. dahlianum* and *P. cornwallisense* D. Löve are very similar but differ in the following characters: *P. dahlianum* has more stamens (30–50 stamens) than *P. cornwallisense* (≤24 stamens); *P. dahlianum* has longer buds (10–14 mm long) than *P. cornwallisense* (≤10 mm long); and *P. dahlianum* has nearly flat stigmatic discs, whereas they are convex in *P. cornwallisense* (Solstad and Elven unpublished).

Poaceae – Grass family

***Alopecurus magellanicus* Lamarck**

Syn.: *Alopecurus borealis* Trinuis

Figure 10A, B

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°27′37″N, 062°51′53″W; 16 m a.s.l.; 20 Jul. 2019; habitat: wetland on the margins of a lake, with peat and silty sand as substrates, dominated by moss, *Eriophorum scheuchzeri*, and *Eriophorum triste*; QFA0635548.

Identification. Plants 9–16 cm high; herbaceous; not caespitose. Fibrous roots and rhizomes present. Stems 8.0–14.5 cm long; erect; glabrous. Leaves basal and cauline; alternate. Sheath margins glabrous. Ligules

0.9–1.0 mm long. Basal leaf blades 27–38 mm long, 2–4 mm wide; linear; flat and sometimes rolled in bud apically; abaxial surface glabrous; adaxial surface scabrous; margins glabrous or scabrous. Flag leaf blades 10–14 mm long, 2.0–4.5 mm wide. Inflorescence a dense ovate panicle; 9–11 mm long. Branches at lowest inflorescence node 2–4; 0.5–1.5 mm long. Pedicels hairy. Spikelets 2.6–3.2 mm long, 1.1–1.5 mm wide. Floret per spikelet 1. First glumes 2.5–2.8 mm long; lanceolate; surface hairy, with long silky hairs; margins ciliate; apices acute. Second glumes 2.6–2.9 mm long (almost as long as, or longer than, the lowest floret); lanceolate; keeled; veins 3; surface hairy, with long silky hairs; margins ciliate; apices acute. Lemmas 2.2–2.9 mm long, 0.8–1.1; ovate or lanceolate; keeled; veins 3–5; surface dull, glabrous, and hairy, with few hairs on and between the veins; apices rounded or erose, and ciliate; awned. Awns 1.8–2.0 mm long; arising from the middle to below the apices. Palea absent. Androecium with 3 stamens and 1.3–2.2 mm long anthers. Gynoecium with 2 styles.

Figure 9. Papaveraceae. **A.** *Papaver dahlianum* Nordhagen habit and **B.** flower. Photos A by Émilie Desjardins and B by Jae Lapid.

Arctagrostis latifolia (R. Brown) Grisebach subsp. *latifolia*

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°29′14″N, 062°02′05″W; 20 m a.s.l.; 30 Jul. 2019; habitat: wetland near the ocean shore, with tussocks made of peat, dominated by *Eriophorum triste* and *Alopecurus magellanicus*; QFA0635519 • same locality; 82°27′49″N, 062°34′42″W; 126 m a.s.l.; 25 Jul. 2019; habitat: wetland, with tussocks made of peat and till, dominated by *Eriophorum triste*, *Arctagrostis latifolia*, and *Alopecurus magellanicus*; QFA0635547.

Identification. Plants 14–27 cm high; herbaceous; not caespitose. Fibrous roots and rhizomes present. Stems 10–21 cm long; erect; glabrous. Leaves basal and cauline; alternate. Sheath margins scaberulous. Ligules 1.3–2.1 mm long. Basal leaf blades 16–58 mm long, 1.6–6.0 mm wide; linear; flat or involute; abaxial and adaxial surfaces both scabrous; margins scabrous. Flag leaf blades 9–12 mm long, 0.8–1.5 mm wide. Inflorescence a dense or diffuse panicle; 30–75 mm long. Branches at lowest inflorescence node 4–5; 2.1–18.0 mm long. Pedicels scabrous. Spikelets 4.0–4.8 mm long, 1.1–1.3 mm wide. Florets per spikelet 1–2. First glumes 2.4–2.9 mm long; lanceolate; surface glabrous; margins glabrous; apices acute. Second glumes 2.9–3.7 mm long (shorter than the lowest floret); lanceolate; vein 1; surface glabrous; margins glabrous; apices acute. Lemmas 4.1–4.7 mm long, 0.7–0.9 mm wide; lanceolate; keeled; veins 3–5; surface dull and scabrous; apices acute and glabrous; awnless. Palea 3.9–4.1 mm long; veins scabrous. Rachilla between first and second lemmas 0.4–1.0 mm long. Androecium with 3 stamens and 2.0–2.4 mm long anthers. Gynoecium with 2 styles.

Deschampsia cespitosa (Linnaeus) Palisot de Beauvois subsp. *septentrionalis* Chiapella

Syn.: *Deschampsia brevifolia* R. Brown

Figure 11A

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°26′40″N, 062°43′09″W; 210 m a.s.l.; 14 Jul. 2019; habitat: mesic, with peat and till as substrates, dominated by *Juncus biglumis*, moss, and blue-green algae (macroscopic sheet colonies dominated by *Nostoc* sp.); QFA0635545 • same locality; 82°29′58″N, 062°33′46″W; 65 m a.s.l.; 6 Jul. 2019; habitat: mesic, with polygonal patterned ground made of till, dominated by *Alopecurus magellanicus* and moss; QFA0635546.

Identification. Plants 4–10 cm high; herbaceous; caespitose. Fibrous roots present. Stems 2–8 cm long; erect; glabrous. Leaves basal and cauline. Sheath margins glabrous. Ligules 2.6–3.7 mm long. Basal leaf blades 15–45 mm long, 0.4–1.1 mm wide; linear; rolled in bud or

Figure 10. Poaceae. **A.** *Alopecurus magellanicus* Lamarck habitat and **B.** habit. **C.** *Festuca brachyphylla* Schultes & Schultes f. subsp. *brachyphylla* habit. **D.** *Poa abbreviata* R. Brown subsp. *abbreviata* habit and **E.** inflorescence. **F.** *Puccinellia angustata* (R. Brown) E.L. Rand & Redfield habit. Photos A by Audrey Le Pogam, B, D, by Émilie Desjardins, C by Jacob Caron Carrier, E by Sandra Lai, and F by Andrew Tam.

folded; abaxial surface glabrous; adaxial surface scabrous and hairy, with few short hairs apically; margins scabrous. Flag leaf blades 11.0–13.3 mm long, 0.5–0.6 (1.0–1.1 flat) mm wide. Inflorescence a dense panicle; 17–22 mm long. Branches at lowest inflorescence node 3–4; 1.8–6.2 mm long. Pedicels glabrous. Spikelets 3.6–4.9 mm long, 0.6–1.8 mm wide. Florets per spikelet 1–2. First glumes 2.7–3.1 mm long; lanceolate; surface glabrous; margins glabrous; apices acuminate or acute. Second glumes 2.8–3.4 mm long (almost as long as the lowest floret); lanceolate; veins 1–3; surface glabrous; margins glabrous; apices acute. Lemmas 2.7–3.1

mm long, 0.5–0.7 mm wide; lanceolate; keeled; veins 5; surface shiny, glabrous, and hairy, with long hairs only at the base; apices acute or erose, and glabrous; awned. Awns 1.0–1.4 mm long; arising from the middle or below. Palea 1.8–2.6 mm long; veins scabrous. Rachilla between first and second lemmas 0.9–2.1 mm long. Androecium with 3 stamens and 0.9–1.4 mm long anthers. Gynoecium with 2 styles.

Deschampsia brevifolia and *D. sukatschewii* (Poplavskaja) Roshevitz are the two *Deschampsia* Palisot de Beauvois species on Ellesmere Island (Aiken et al. 2007; GBIF 2020). They can be differentiated by the following: *D. brevifolia* has dense panicles with strongly imbricate spikelets, whereas *D. sukatschewii* usually has open panicles with no or only moderately imbricate spikelets (Barkworth 2007; Saarela et al. 2020); the glumes and lemmas of *D. brevifolia* are usually dark purple proximally for over >½ of their surface, whereas they usually are dark purple proximally over <½ of their surface in *D. sukatschewii* (Barkworth 2007; Saarela et al. 2020); *D. brevifolia* has keeled lemmas, whereas *D. sukatschewii* has rounded on the back lemmas (Aiken et al. 2007); and *D. brevifolia* has scabrous palea veins, whereas *D. sukatschewii* has glabrous palea veins (Aiken et al. 2007).

***Festuca baffinensis* Polunin**

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°30′04″N, 062°52′41″W; 91 m a.s.l.; 2 Aug. 2019; habitat: xeric in a slope, with hummocks made of till and rocks, and sparse dominance of *Saxifraga oppositifolia* and moss; QFA0635544.

Identification. Plants 6.5–11.0 cm high; herbaceous; caespitose. Fibrous roots present. Stems 5–9 cm long; erect or ascending; hairy, with short hyaline hairs (densely hairy below the inflorescence). Leaves basal and cauline. Sheath margins glabrous. Ligules 0.1–0.2 mm long. Basal leaf blades 21–35 mm long, 0.3–0.4 mm wide; linear; rolled in bud or folded; abaxial surface glabrous; adaxial surface glabrous or hairy, with few short hairs; margins scabrous. Flag leaf blades 10.1–11.0 mm long, 0.3–0.5 mm wide; tip linear. Inflorescence a dense panicle; 14–25 mm long. Branches at lowest inflorescence node 1–2; 1.9–5.2 mm long. Pedicels scabrous. Spikelets 4.2–6.5 mm long, 1.9–3.1 mm wide. Florets per spikelet 2–3. First glumes 2.1–3.5 mm long; lanceolate; surface glabrous; margins ciliate; apices acuminate. Second glumes 3.3–4.0 mm long (shorter than the lowest floret); lanceolate; veins 3; surface glabrous; margins ciliate; apices acuminate. Lemmas 3.2–4.3 mm long, 0.6–0.9 mm wide; lanceolate; rounded on the back; veins 4–5; surface dull and sparsely scabrous; apices ciliate; awned. Awn 1.4–1.6 mm long; arising from the tip. Palea 4.4–4.8 mm long; veins scabrous. Rachilla between first and second lemmas 0.4–1.1 mm long. Androecium with 3 stamens and 0.6–1.0 mm long. Gynoecium with 2 styles.

The five *Festuca* Linnaeus species present on Ellesmere Island (GBIF 2020) were found in our survey. Among the four *Festuca* species without pseudoviviparous spikelets (*F. baffinensis*, *F. brachyphylla* Schultes & Schultes f. subsp. *brachyphylla*, *F. edlundiae* S.G. Aiken, Consaul, & Lefkovitch, and *F. hyperborea* Holmen ex Frederiksen; Aiken et al. 2007), *F. baffinensis* can be differentiated by having dense, short hairs on the culms, especially below the inflorescence, whereas *F. brachyphylla*, *F. edlundiae*, and *F. hyperborea* have glabrous or sparsely hairy culms (Aiken et al. 1995; Aiken et al. 2007).

Festuca brachyphylla* Schultes & Schultes f. subsp. *brachyphylla

Figures 10C, 12A

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°26′38″N, 062°11′23″W; 178 m a.s.l.; 23 Jul. 2019; habitat: mesic, with polygonal patterned ground made of till, dominated by *Alopecurus magellanicus*; QFA0635541.

Identification. Plants 3.5–8.5 cm high; herbaceous; caespitose. Fibrous roots present. Stems 2.5–8.0 cm long; erect, ascending, or semi-prostrate; glabrous. Leaves basal and cauline. Sheath margins glabrous. Ligules 0.2–0.4 mm long. Basal leaf blades 14–22 mm long, 0.4–1.1 mm wide; linear; rolled in bud; abaxial surface glabrous; adaxial surface glabrous or scaberulous; margins scabrous. Flag leaf blades 2.8–7.0 mm long, 0.2–0.4 mm wide; tip linear. Inflorescence a dense panicle; 10–18 mm long. Branch at lowest inflorescence node 1; 1.9–2.1 mm long. Pedicels scabrous. Spikelets 5.9–6.2 mm long, 3.0–4.1 mm wide. Florets per spikelet 2–4. First glumes 1.8–2.3 mm long; lanceolate; surface glabrous; margins ciliate; apices acuminate. Second glumes 2.7–3.4 mm long (shorter than the lowest floret); lanceolate; veins 3; surface glabrous; margins ciliate; apices acute. Lemmas 3.3–4.1 mm long, 0.6–0.8 mm wide; lanceolate; rounded on the back; veins 5; surface dull and sparsely scabrous; apices glabrous or ciliate; awned. Awn 0.7–1.2 mm long; arising from the tip. Palea 3.6–3.9 mm long; veins scabrous. Rachilla between first and second lemmas 0.6–1.1 mm long. Androecium with 3 stamens and 1.0–1.3 mm long anthers. Gynoecium with 2 styles.

Festuca brachyphylla subsp. *brachyphylla*, *F. edlundiae*, and *F. hyperborea* are very similar and can be differentiated by the following characters: short flag leaf blade with a spoon-shaped tip in *F. hyperborea* (0–8 mm long but usually <5 mm), whereas the flag leaf blade is longer with a linear tip in *F. brachyphylla* and *F. edlundiae* (2–15 mm long); culms of *F. edlundiae* are often semi-prostate (erect only at anthesis), whereas culms of the other species are erect; leaf cross section in *F. edlundiae* shows five well-developed ribs, whereas *F. brachyphylla* has one well-defined rib and 2–4 variously defined ribs, and *F. hyperborea* has five but less defined ribs than *F. edlundiae* (Fig. 12; Aiken et al. 1995). Moreover,

Figure 11. Dry specimens of Poaceae spp. **A.** *Deschampsia cespitosa* (Linnaeus) Palisot de Beauvois subsp. *septentrionalis* Chiapella inflorescence. **B.** *Festuca edlundiae* S.G. Aiken, Consaul, & Lefkovitch inflorescence. **C.** *Festuca hyperborea* Holmen ex Frederiksen inflorescence and **D.** flag leaf blade. **E.** *Festuca viviparoidea* Krajina ex Pavlick subsp. *viviparoidea* inflorescence. **F.** *Phippsia algida* (Solander) R. Brown inflorescence. **G.** *Poa abbreviata* R. Brown subsp. *abbreviata* inflorescence. **H.** *Poa arctica* R. Brown subsp. *arctica* inflorescence. **I.** *Poa pratensis* Linnaeus subsp. *colpodea* (Th. Fries) Tzvelev inflorescence. **J.** *Puccinellia angustata* (R. Brown) E.L. Rand & Redfield inflorescence. **K.** *Puccinellia bruggemannii* T.J. Sørensen inflorescences. **L.** *Puccinellia vahliana* (Liebmann) Scribner & Merrill inflorescences. **M.** ×*Puccinellia vacillans* (T. Fries) Tzvelev inflorescence. Photos A–M by Kim Damboise. Scale bar: 1 cm.

shorter plants of *F. brachyphylla* are superficially similar to *F. hyperborea* but are separated by the shape of the second glumes, which are supposed to be lanceolate in *F. brachyphylla* and obovate in *F. hyperborea* (Aiken et al. 1995; Aiken et al. 2007). However, we did not observe obovate second glumes in *F. hyperborea*; instead, they were more lanceolate or oblong.

Festuca edlundiae S.G. Aiken, Consaul, & Lefkovitch

Figures 11B, 12B

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°26′58″N, 062°33′50″W; 198 m a.s.l.; 17 Jul. 2019; habitat: mesic, with polygonal patterned ground made of till and rocks, dominated by *Phippsia*

algida (Solander) R. Brown, *Juncus biglumis*, and moss; QFA0635542 • same locality; 82°26′42″N, 062°12′12″W; 184 m a.s.l.; 23 Jul. 2019; habitat: xeric, with polygonal patterned ground made of till and rocks, and sparse dominance of *Saxifraga oppositifolia*; QFA0635543.

Identification. Plants 5.5–7.5 cm high; herbaceous; caespitose. Fibrous roots present. Stems 4.5–7.0 cm long; prostrate, semi-prostrate, or ascending; glabrous. Leaves basal and cauline. Sheath margins glabrous. Ligules 0.4–0.5 mm long. Basal leaf blades 20–26 mm long, 0.4–0.7 mm wide; linear; rolled in bud; abaxial surface glabrous or scabrous; adaxial surface glabrous; margins scabrous or glabrous. Flag leaf blades 5–14 mm long, 0.3–0.4 mm wide; tip linear. Inflorescence a dense panicle; 11–20 mm long. Branches at lowest inflorescence node 1–2; 1.1–3.2 mm long. Pedicels scabrous. Spikelets 6.0–7.9 mm long, 3.3–3.8 mm wide. Florets per spikelet 2–4. First glumes 1.8–2.2 mm long; lanceolate; surface glabrous; margins glabrous; apices acuminate. Second glumes 2.4–4.3 mm long (shorter than the lowest floret); ovate; veins 1–3; surface glabrous; margins ciliate; apices acute. Lemmas 3.2–4.1 mm long, 0.7–0.9 mm wide; lanceolate; rounded on the back; veins 5; surface dull and sparsely scabrous; apices ciliate; awned. Awn 0.9–1.3 mm long; arising from the tip. Palea 3.6–3.8 mm long; veins scabrous. Rachilla between first and second lemmas 0.9–1.0 mm long. Androecium with 3 stamens and 1.0–1.9 mm long anthers. Gynoecium with 2 styles.

Characteristics allowing to distinguish *F. edlundiae* from the other *Festuca* species present on Ellesmere Island can be found under *F. baffinensis* and *F. brachyphylla* subsp. *brachyphylla*.

Festuca hyperborea Holmen ex Frederiksen

Figures 11C, D, 12C

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°27′41″N, 062°01′06″W; 121 m a.s.l.; 6 Aug. 2019; habitat: mesic habitat, with till and rocks as substrates, dominated by *Saxifraga oppositifolia* and moss; QFA0635522.

Identification. Plants 4.5–9.0 cm high; herbaceous; caespitose. Fibrous roots present. Stems 3.5–7.0 cm long; erect or ascending; glabrous. Leaves basal and cauline. Sheath margins glabrous. Ligules 0.3–0.5 mm long. Basal leaf blades 3.5–28.0 mm long, 0.2–0.6 mm wide; linear; rolled in bud; abaxial and adaxial surfaces both glabrous; margins scabrous. Flag leaf blades 0.5–3.7 mm long, 0.2–0.4 mm wide; tip spoon–shaped. Inflorescence a dense panicle; 12–18 mm long. Branch at lowest inflorescence node 1; 0.9–2.3 mm long. Pedicels scabrous. Spikelets 6.4–6.8 mm long, 2.5–2.9 mm wide. Florets per spikelet 2–4. First glumes 1.8–2.7 mm long; lanceolate; surface glabrous; margins ciliate; apices acuminate. Second glumes 2–3 mm long (shorter than the lowest floret); lanceolate or oblong; veins 3; surface glabrous; margins ciliate; apices acute. Lemmas 3.4–3.9 mm long, 0.8–0.9 mm wide; lanceolate; rounded on the back; veins 5; surface dull and sparsely scabrous; apices ciliate; awned. Awn 1.3–1.7 mm long; arising from the tip or slightly below. Palea 3.3–3.6 mm long; veins scabrous. Rachilla between first and second lemmas 0.7–1.0 mm long. Androecium with 3 stamens and 0.5–1.5 mm long anthers. Gynoecium with 2 styles.

Characteristics allowing to distinguish *F. hyperborea* from the other *Festuca* species present on Ellesmere Island can be found under *F. baffinensis* and *F. brachyphylla* subsp. *brachyphylla*.

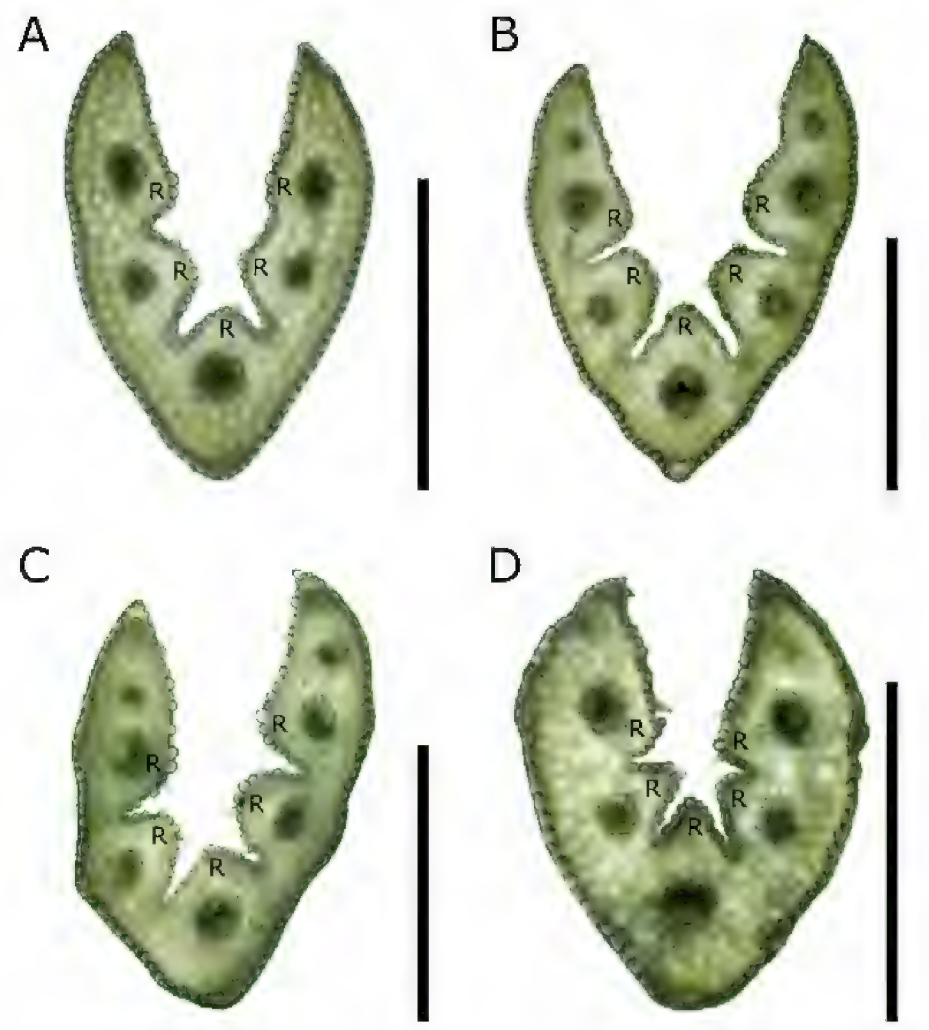

Figure 12. Leaf blade cross sections of *Festuca* Linnaeus spp. **A.** *Festuca brachyphylla* Schultes & Schultes f. subsp. *brachyphylla* leaf cross section. **B.** *Festuca edlundiae* S.G. Aiken, Consaul, & Lefkovitch leaf cross section. **C.** *Festuca hyperborea* Holmen ex Frederiksen leaf cross section. **D.** *Festuca viviparoidea* Krajina ex Pavlick subsp. *viviparoidea* leaf cross section. Photos A–D by Martin Dubé. Scale bar: 500 µm. Leaf cross sections were obtained by cutting a <1 mm long section between the first 1/3 and the middle of the basal leaf blades. Leaf cross section in *F. brachyphylla* subsp. *brachyphylla* (A) shows five variously defined ribs with only the midrib being delimited by deep grooves approximately reaching the vein level. Leaf cross section in *F. hyperborea* (C) usually shows even less well-defined ribs than *F. brachyphylla* subsp. *brachyphylla* (which is not the case here) but retains the same looking midrib. Compared to these two species, *F. edlundiae* (B) presents midrib grooves that are deeper and go beyond the vein level while the other lateral ribs are also consistently well-defined. In *F. viviparoidea* subsp. *viviparoidea* (D), the grooves are shallow with well-defined but still small ribs, giving that species unique anatomical facies among *Festuca* species in Canada (M Dubé personal observation). Ribs, identified by R letters, are the longitudinal bumps containing veins and are delimited by the contiguous grooves (however, some veins may not be included within the ribs).

Festuca viviparoidea Krajina ex Pavlick subsp. *viviparoidea*

Figures 11E, 12D

Materials examined. CANADA – **Nunavut** • Ellesmere

Island, CFS Alert; 82°30′04″N, 062°52′41″W; 93 m a.s.l.; 2 Aug. 2019; habitat: xeric in a slope, with hummocks made of till and rocks, dominated by *Saxifraga oppositifolia* and moss; QFA0635517 • same locality; 82°29′12″N, 062°50′55″W; 86 m a.s.l.; 27 Aug. 2019; habitat: mesic in a slope, with peat and till as substrates, dominated by *Salix arctica*, *Saxifraga oppositifolia*, *Stellaria longipes*, and *Puccinellia vahliana* (Liebmann) Scribner & Merrill; QFA0635540 • same locality; 82°30′21″N, 062°41′20″W; 66 m a.s.l.; 1 Aug. 2019; habitat: mesic in a slope, with till and rocks as substrates, dominated by *Salix arctica*; QFA0635587.

Identification. Plants 7.0–15.5 cm high; herbaceous; caespitose. Fibrous roots present. Stems 6–14 cm long; erect; glabrous and scabrous on angles below the inflorescence. Leaves basal and cauline. Sheath margins glabrous or hairy, with short simple hairs. Ligules 0.2–0.5 mm long. Basal leaf blades 12–25 mm long, 0.3–0.7 mm wide; linear; folded or rolled in bud; abaxial surface glabrous or scabrous; adaxial surface scabrous; margins glabrous or scabrous. Flag leaf blades 10.9–11.2 mm long, 0.2–0.3 mm wide; tip linear. Inflorescence a dense panicle, with bulbils allowing vegetative reproduction; 26–30 mm long. Branch at lowest inflorescence node 1; 1.5–2.2 mm long. Pedicels scabrous. Spikelets 10–14 mm long, 1.1–2.0 mm wide. Florets per spikelet 2 or 3. First glumes 2.8–3.1 mm long; lanceolate; surface glabrous or hairy, with hairs at the apices only; margins ciliate; apices acuminate. Second glumes 3.9–4.0 mm long (shorter than the lowest lemma); lanceolate; veins 3; surface glabrous and scabrous apically; margins ciliate; apices acute. Lemmas 4.1–6.7 mm long, 0.6–0.8 mm wide; lanceolate; keeled; veins 5; surface dull, sparsely scabrous, and hairy apically (on the projection), with short hairs; apices acuminate and glabrous; awnless. Palea vestigial or absent. Rachilla absent. Bulbils 3.3–9.6 mm long. Androecium and gynoecium absent.

Among the five *Festuca* species present on Ellesmere Island (GBIF 2020), *F. viviparoidea* subsp. *viviparoidea* is the only one with pseudoviviparous spikelets (in contrast to *F. baffinensis*, *F. brachyphylla* subsp. *brachyphylla*, *F. edlundiae*, and *F. hyperborea*; Aiken et al. 2007).

Phippsia algida (Solander) R. Brown

Figure 11F

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°26′40″N, 062°43′09″W; 210 m a.s.l.; 14 Jul. 2019; habitat: mesic, with peat and rocks as substrates, dominated by *Juncus biglumis*, moss, and blue-green algae (macroscopic sheet colonies dominated by *Nostoc* sp.); QFA0635538 • same locality; 82°25′52″N, 062°07′49″W; 296 m a.s.l.; 16 Jul. 2019; habitat: wetland in a mountain pass, with peat and rocks as substrates, dominated by moss and *Saxifraga cernua*; QFA0635539.

Identification. Plants 3.5–6.0 cm high; herbaceous; caespitose. Fibrous roots present. Stems 2.5–4.0 cm long; erect, ascending, or decumbent; glabrous. Leaves basal and cauline. Sheath margins glabrous. Ligules 0.8–1.0 mm long. Basal leaf blades 8–20 mm long, 0.8–1.2 (1.5–2.8 flat) mm wide; linear; folded or flat; abaxial and adaxial surfaces both glabrous; margins glabrous. Flag leaf blades 6–13 mm long, 0.7–1.2 (1.7–2.1 flat) mm wide. Inflorescence a dense panicle; 9–20 mm long. Branches at lowest inflorescence node 4–6; 1.0–2.8 mm long. Pedicels glabrous. Spikelets 1.6–2.3 mm long, 0.8–1.1 mm wide. Floret per spikelet 1. First glumes 0.3–0.5 mm long; ovate; surface glabrous; margins glabrous; apices obtuse. Second glumes 0.4–0.7 mm long (shorter than the lowest floret); ovate; veins indistinct; surface glabrous; margins glabrous; apices obtuse. Lemmas 1.4–2.0 mm long, 0.7–1.1 mm wide; ovate; rounded on the back; veins 1–3; surface dull, glabrous, and hairy, with hairs on and between the veins proximally (hairs 0.07–0.17 mm long; covering the lower ½ of the lemma surface); apices acute or erose, and glabrous; awnless. Palea 1.3–1.9 mm long; veins hairy. Androecium with 1 or 2 stamens and 0.4–0.6 mm long anthers. Gynoecium with 2 styles. Fruit a caryopsis; 1.4–1.5 mm long, 0.3–0.5 mm wide; ellipsoid.

Most authors recognize two *Phippsia* (Trinius) R. Brown species, *P. algida* and *P. concinna* (Th. Fries) Lindeberg (Steen et al. 2004; Aiken et al. 2007; Consaul and Aiken 2007), although Soreng and contributors (2003) treated the latter taxon as *Phippsia algida* subsp. *concinna* (Th. Fr.) Á. Löve & D. Löve; both taxa are known from Ellesmere Island. The most reliable characters to differentiate the species are the number of stamens (1 or 2 stamens in *P. algida* and 1 stamen in *P. concinna*); caryopsis shape (ellipsoid in *P. algida* and ovoid in *P. concinna*); pedicel angle (5–8° in *P. algida* and 20–108° in *P. concinna*); lemma hairiness (hairs on lower ⅓ or entirely glabrous in *P. algida* and hairs on the ½–⅔ in *P. concinna*); and lemma hair length (0.02–0.15 mm long in *P. algida*, and 0.19–0.24 mm long in *P. concinna*; Aares et al. 2000). In addition, *P. algida* has spikelets that are less than twice as long as wide, whereas *P. concinna* has spikelets 2–3 times longer than wide (Consaul and Aiken 2007). We found that the lemmas of the *P. algida* specimens from Alert had longer hairs (up to 0.17 mm long) on a larger surface (½ of the surface) than reported in the literature.

Phippsia algida can also be mistaken for the hybrid ×*Pucciphippsia vacillans*, which is also known from Alert and is somewhat intermediate between *Phippsia algida* and *Puccinellia vahliana* (Hedberg 1962; Steen et al. 2004). They both have very short glumes (≤0.8 mm long; Aiken et al. 2007), but ×*P. vacillans* differs from *P. algida* by having longer leaf blades (≥30 mm long), more than one floret per spikelet, and panicles with predominantly ascending branches, not erect as in *P. algida* (Aiken et al. 2007).

Pleuropogon sabinei R. Brown

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°26′26″N, 062°01′49″W; 147

m a.s.l.; 23 Jul. 2019; habitat: wetland on the margins of a lake, with peat as substrate, dominated by moss and *Luzula nivalis*; QFA0635537.

Identification. Plants 9.5–19.5 cm high; herbaceous; not caespitose. Fibrous roots and rhizomes present. Stems 5–14 cm long; erect or ascending; glabrous. Leaves basal and cauline. Sheath margins glabrous. Ligules 1.8–2.6 mm long. Basal and cauline leaf blades (attached below the middle of the stem) 24.5–59.0 mm long, 0.9–1.1 (2.0–2.6 flat) mm wide; linear; folded or flat; abaxial and adaxial surfaces both glabrous; margins glabrous. Flag leaf blades absent or present; 8.8–16.0 mm long, 0.9–1.3 mm wide. Inflorescence a diffuse raceme with spikelets attached on one side; 43–60 mm long. Branches at lowest inflorescence node 1; 1–12 mm long. Pedicels glabrous. Spikelets 4.8–12.5 mm long, 1.6–3.5 mm wide. Florets per spikelet 6–10. First glumes 1.5–2.1 mm long; ovate; surface glabrous; margins glabrous; apices obtuse. Second glumes 1.8–2.8 mm long (shorter than the lowest floret); ovate; veins 3; surface glabrous; margins glabrous; apices rounded. Lemmas 3.6–4.0 mm long, 1.1–1.2 mm wide; oblanceolate; rounded on the back; veins 5–7; surface dull and hairy, with short hairs on and between the veins; apices rounded and glabrous; awnless. Palea 3.6–4.2 mm long; veins scabrous; with awn arising near the base of each palea keel; awns 2.6–3.5 mm long. Rachilla between first and second lemmas 0.9–1.3 mm long. Androecium with 3 stamens and 2.2–2.9 mm long anthers. Gynoecium with 2 styles.

Poa abbreviata* R. Brown subsp. *abbreviata
Figures 10D, E, 11G

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°29′43″N, 61°57′15″W; 14 m a.s.l.; 30 Jul. 2019; habitat: xeric in a slope, with till and rocks as substrates, and sparse dominance of *Salix arctica*; QFA0635535 • same locality; 82°28′11″N, 062°05′06″W; 118 m a.s.l.; 18 Jul. 2019; habitat: mesic, with polygonal patterned ground made of till and rocks, dominated by *Stellaria longipes*; QFA0635536.

Identification. Plants 5.0–9.5 cm high; herbaceous; caespitose. Fibrous roots present. Stems 4–8 cm long; erect or ascending; glabrous. Leaves basal and cauline. Sheath margins glabrous. Ligules 0.7–1.0 mm long. Basal leaf blades 12–41 mm long, 0.2–0.8 mm wide; linear; folded or rolled in bud; abaxial and adaxial surfaces both glabrous; margins scabrous or glabrous. Flag leaf blades 3.7–11.0 mm long, 0.3–0.8 mm wide. Inflorescence a dense panicle; 10–21 mm long. Branches at lowest inflorescence node 1–2; 2.1–3.5 mm long. Pedicels glabrous. Spikelets 4.7–5.4 mm long, 1.8–2.4 mm wide. Florets per spikelet 2–4. First glumes 3.0–3.4 mm long; lanceolate; surface glabrous; margins glabrous; apices acuminate or acute. Second glumes 3.3–4.1 mm long (almost as long as the lowest floret); lanceolate or ovate; veins 1–3; surface glabrous; margins glabrous; apices acuminate or acute. Lemmas 3.3–3.8 mm long, 0.8–1.1 mm wide; lanceolate; keeled; veins 5; surface dull and hairy proximally on the ¾ of the surface, with hairs on and between the veins; apices obtuse or erose, and glabrous; awnless. Palea 2.7–3.3 mm long; veins scabrous. Rachilla between first and second lemmas 0.5–1.1 mm long. Androecium with 3 stamens and 0.7–1.2 mm long anthers. Gynoecium with 2 styles.

There are five *Poa* Linnaeus species on Ellesmere Island (*P. abbreviata* subsp. *abbreviata*, *P. arctica* R. Brown subsp. *arctica* and subsp. *caespitans* Simmons ex Nannfeldt, *P. glauca* Vahl subsp. *glauca*, *P. hartzii* Gandoger subsp. *hartzii*, and *P. pratensis* Linnaeus subsp. *alpigena* (Lindman) Hiitonen and subsp. *colpodea* (Th. Fries) Tzvelev; GBIF 2020). Among them, only *P. arctica* subsp. *arctica* and the two *P. pratensis* subspecies have rhizomes (Saarela et al. 2020). *P. abbreviata* subsp. *abbreviata* differs from the remaining caespitose species lacking rhizomes (*P. arctica* subsp. *caespitans*, *P. glauca* subsp. *glauca*, *P. hartzii* subsp. *hartzii*) by having in general a shorter inflorescence (≤2.2 cm long) in contrast to inflorescences reaching up to 6 cm long in the other species (Aiken et al. 2007) and by having well developed and shorter anthers (0.1–1.2 mm long) in contrast to well developed or aborted, 1.0–2.5 mm long anthers (Saarela et al. 2020).

Poa arctica* R. Brown subsp. *arctica
Figures 11H

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°26′26″N, 062°01′49″W; 147 m a.s.l.; 23 Jul. 2019; habitat: wetland on the margins of a lake, with peat as substrate, dominated by moss and *Luzula nivalis*; QFA0635534.

Identification. Plants 5.3–12.5 cm high; herbaceous; not caespitose. Fibrous roots and rhizomes present. Stems 2.5–10.0 cm long; erect or ascending; glabrous. Leaves basal and cauline. Sheath margins glabrous. Ligules 1.3–1.7 mm long. Basal leaf blades 21–26 mm long, 0.6–0.8 (1.5–1.8 flat) mm wide; linear; rolled or folded in bud; abaxial surface glabrous and scabrous apically; adaxial surface glabrous; margins scabrous. Flag leaf blades 12.5–13.9 mm long, 0.7–0.9 mm wide. Inflorescence a diffuse panicle; 21.0–31.5 mm long. Branches at lowest inflorescence node 1–3; 10–22 mm long. Pedicels scabrous. Spikelets 3.7–5.1 mm long, 0.9–2.3 mm wide. Florets per spikelet 1–4. First glumes 2.6–3.2 mm long; lanceolate; surface glabrous; margins glabrous; apices acuminate. Second glumes 3.1–3.5 mm long (shorter than, or almost as long as, the lowest floret); lanceolate or ovate; veins 3; surface glabrous and scabrous on midvein; margins glabrous; apices acute. Lemmas 3.1–3.5 mm, long 1.0–1.2 mm wide; ovate or lanceolate; keeled; veins 5; surface dull, glabrous, and hairy, with hairs on and between the veins proximally; apices acute or erose, and glabrous; awnless. Palea 2.4–3.5 mm long; veins hairy, with short (proximally) and long hairs (in the middle) (hairs also present between the veins). Rachilla between first and second lemmas 1.1–2.0 mm long. Androecium

with 3 stamens and 1.3–1.5 mm long anthers. Gynoecium with 2 styles.

Two *Poa* species present on Ellesmere Island have rhizomes (*P. arctica* subsp. *arctica* and *P. pratensis* subsp. *arctica* and subsp. *caespitans*; GBIF 2020). They can be differentiated based on the following: *P. pratensis* subsp. *colpodea* has at least some bulbiferous spikelets (in contrast to the others that do not have bulbils at all; Aiken et al. 2007); *P. arctica* subsp. *arctica* has open, pyramidal inflorescences, whereas both *P. pratensis* subspecies have usually contracted, lanceolate or narrowly pyramidal inflorescences (Aiken et al. 2007; Saarela et al. 2020); and *P. arctica* subsp. *arctica* has paleas softly puberulent between keels, whereas both *P. pratensis* subspecies have paleas glabrous between keels (Saarela et al. 2020).

***Poa pratensis* Linnaeus subsp. *colpodea* (Th. Fries) Tzvelev**

Figures 11I

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°28′ N, 062°06′ W; 117 m a.s.l.; 18 Aug. 2019; habitat: around an Arctic fox den; QFA0635518 • same locality; 82°28′16″N, 062°06′24″W; 122 m a.s.l.; 18 Jul. 2019; habitat: around a bird perching site; QFA0635533.

Identification. Plants 7.5–16.5 cm high; herbaceous; not caespitose. Fibrous roots and rhizomes present. Stems 5.5–14.0 cm long; erect; glabrous. Leaves basal and cauline. Sheath margins glabrous. Ligules 0.8–1.3 mm long. Basal leaf blades 17–46 mm long, 0.8–1.1 mm wide; linear; folded or rolled in bud; abaxial and adaxial surfaces both glabrous; margins glabrous. Flag leaf blades 8.5–9.5 mm long, 0.3–0.6 mm wide. Inflorescence a diffuse or dense panicle, with bulbils allowing vegetative reproduction; 22.0–33.5 mm long. Branches at lowest inflorescence node 2 or 3; 0.9–2.8 mm long. Pedicels glabrous. Spikelets 4–9 mm long, 1.5–2.3 mm wide. Florets per spikelet 1–3. First glumes 2.3–3.0 mm long; ovate; surface glabrous; margins glabrous; apices acute or acuminate. Second glumes 2.0–2.9 mm long (shorter than, or almost as long as, the lowest lemma); ovate or lanceolate; veins 3; surface glabrous and scabrous on the midvein (midvein sometimes glabrous); margins glabrous; apices acute or acuminate. Lemmas 2.1–3.7 mm long, 0.6–1.7 mm wide; lanceolate; keeled; veins 5; surface dull, glabrous proximally, hairy on the veins, and scabrous apically; apices acute and glabrous; awnless. Palea present or absent; 1.6–1.8 mm long; veins scabrous (hairs absent between the veins). Rachilla between first and second lemmas 0.2–0.3 mm long. Bulbils 3.4–8.9 mm long. Androecium and gynoecium absent.

Characteristics allowing to distinguish *P. pratensis* subsp. *colpodea* from the other *Poa* species present on Ellesmere Island can be found under *P. abbreviata* subsp. *abbreviata* and *P. arctica* subsp. *arctica*.

***Puccinellia angustata* (R. Brown) E.L. Rand & Redfield**

Figures 10F, 11J

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°31′04″N, 062°28′48″W; 66 m a.s.l.; 27 Jul. 2019; habitat: mesic, with hummocks made of till, dominated by *Stellaria longipes*, *Saxifraga oppositifolia*, and moss; QFA0635529 • same locality; 82°29′56″N, 062°19′19″W; 48 m a.s.l.; 8 Aug. 2019; habitat: xeric near the sewage outlet, with till and rocks as substrates, and sparse dominance of *Puccinellia angustata* and *Cochlearia groenlandica*; QFA0635530.

Identification. Plants 10.5–24.0 cm high; herbaceous; caespitose. Fibrous roots present. Stems 8–21 cm long; erect, ascending, or prostrate; glabrous and sometimes scabrous below the inflorescence. Leaves basal and cauline. Sheath margins glabrous or scabrous. Ligules 1.3–1.7 mm long. Basal leaf blades 25–84 mm long, 0.7–0.9 (1.4–1.5 flat) mm wide; linear; rolled in bud or flat; abaxial and adaxial surfaces both glabrous; margins glabrous or scabrous. Flag leaf blades 26–48 mm long, 0.3–0.1 mm wide. Inflorescence a diffuse or dense panicle; 30–57 mm long. Branches at lowest inflorescence node 3; 2.9–11.5 mm long. Pedicels scabrous. Spikelets 4.1–6.7 mm long, 1.5–2.0 mm wide. Florets per spikelet 3–5. First glumes 1.0–1.6 mm long; lanceolate; surface glabrous; margins scabrous; apices acuminate. Second glumes 2.4–2.8 mm long (shorter than the lowest floret); lanceolate; veins 3; surface glabrous; margins scabrous; apices acuminate. Lemmas 3.0–3.9 mm long, 0.6–0.8 mm wide; lanceolate; rounded on the back and with straight lemma tips; veins 4 or 5; surface dull, glabrous, and hairy, with hairs on and between the veins proximally; apices acute or erose, and glabrous or scabrous; awnless. Palea 2.4–2.8 mm long; veins hairy proximally, with curly simple hairs, and scabrous apically. Rachilla between first and second lemmas 1.0–1.5 mm long. Androecium with 3 stamens and 0.8–1.2 mm long anthers. Gynoecium with 2 styles.

There are seven *Puccinellia* Parlatore species present on Ellesmere Island (GBIF 2020). One of them, *P. phryganodes* subsp. *neoarctica*, is spreading by leafy stolons, whereas the others are caespitose and do not have stolons (Consaul and Gillespie 2001; Aiken et al. 2007). The remaining species can be separated using the following combination of characters: in *P. angustata*, *P. bruggemannii*, and *P. vahliana* the palea veins have curly, intertwined hairs proximally and are scabrous apically, in contrast to being glabrous proximally and scabrous or smooth distally in *P. andersonii* Swallen, *P. arctica* (Hooker) Fernald & Weatherby, and *P. vaginata* (Lange) Fernald & Weatherby (Aiken et al. 2007; Saarela et al. 2020). Among the three former species, *P. vahliana* has smooth pedicels, whereas they are scabrous in *P. angustata* and *P. bruggemannii* (Saarela et al. 2020). Inflorescences, second glumes, and lemmas are reported to be longer in *P. angustata* (inflorescences 4–13 cm long; second glumes 1.9–3.0 mm long, with a length-width ratio

of 0.3–0.6; lemmas 3.5–5.2 mm long) than in *P. bruggemannii* (inflorescences 1–4 cm long; second glumes 1.7–2.3 mm long, with a length-width ratio of 0.5–0.8; lemmas 2.8–3.8 mm long; Saarela et al. 2020). However, we found that using only the length of the inflorescences, glumes, and lemmas did not unambiguously differentiate the two species. Indeed, we had specimens of *P. angustata* with shorter inflorescences (e.g., 3 cm long) and lemmas (e.g., 3 mm long), and specimens of *P. bruggemannii* with longer inflorescences (e.g., 4.5 cm long), glumes (e.g., 2.9 mm long), and lemmas (e.g., 4 mm long). We found however that the presence of incurved lemma tips in *P. bruggemannii* and straight lemma tips in *P. angustata* was a good identification criterion, as well as an anther length >0.8 mm and a plant height >10 cm (Consaul et al. 2008a; Saarela et al. 2020).

***Puccinellia bruggemannii* T.J. Sørensen**
Figure 11K

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°27′28″N, 062°03′55″W; 140 m a.s.l.; 26 Jul. 2019; habitat: xeric, with polygonal patterned ground made of till and rocks, and sparse dominance of *Stellaria longipes* and *Saxifraga oppositifolia*; QFA0635526 • same locality; 82°24′36″N, 062°43′04″W; 369 m a.s.l.; 17 Jul. 2019; habitat: barren ground, with till and rocks as substrates; QFA0635527 • same locality; 82°28′01″N, 062°10′01″W; 141 m a.s.l.; 18 Jul. 2019; habitat: xeric, with polygonal patterned ground made of till and rocks, and sparse dominance of *Saxifraga oppositifolia*; QFA0635528.

Identification. Plants 4–10 cm high; herbaceous; caespitose. Fibrous roots present. Stems 2–8 cm long; erect, ascending, or semi-prostrate; glabrous. Leaves basal and cauline. Sheath margins glabrous or scabrous. Ligules 0.4–1.4 mm long. Basal leaf blades 8–30 mm long, 0.4–0.9 mm wide; linear; folded or rolled in bud; abaxial and adaxial surfaces both glabrous; margins glabrous. Flag leaf blades 2.8–20.0 mm long, 0.4–0.7 mm wide. Inflorescence a dense panicle; 12–45 mm long. Branches at lowest inflorescence node 2–3; 1.4–9.5 mm long. Pedicels scabrous. Spikelets 3.5–4.1 mm long, 1.6–2.5 mm wide. Florets per spikelet 2–4. First glumes 1.1–2.0 mm long; ovate; surface glabrous; margins glabrous or scabrous; apices acute. Second glumes 1.9–2.9 mm long (shorter than, or almost as long as, the lowest floret); lanceolate; veins 3; surface glabrous; margins glabrous or scabrous; apices obtuse. Lemmas 2.2–4.0 mm long, 0.5–0.9 mm wide; elliptic; rounded on the back and with incurved lemma tips; veins 5; surface dull (and shiny apically), glabrous, and hairy, with hairs on the veins proximally; apices acute or erose, and slightly scabrous; tip incurved; awnless. Palea 2.3–2.9 mm long; veins hairy proximally, with simple curly hairs, and scabrous apically. Rachilla between first and second lemmas 0.7–1.2 mm long. Androecium with 3 stamens and 0.6–0.8 mm long anthers. Gynoecium with 2 styles.

Characteristics allowing to distinguish *P. bruggemannii* from the other *Puccinellia* species present on Ellesmere Island can be found under *P. angustata*.

***Puccinellia phryganodes* (Trinius) Scribner & Merrill subsp. *neoarctica* (Á. Löve & D. Löve) Elven**

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°31′31″N, 062°11′49″W; 0 m a.s.l.; 3 Aug. 2019; habitat: ocean shore, with sand and rocks as substrates; QFA0635525.

Identification. Plants 2.0–3.5 cm high; herbaceous; caespitose. Fibrous roots and stolons (growing in a zigzag pattern) present. Stolons 2–8 cm long; prostrate; glabrous. Leaves basal and along the stolons. Sheath margins glabrous. Ligules 0.3–0.8 mm long. Basal leaf blades 10.0–19.8 mm long, 0.2–0.5 mm wide; linear; involute, rolled in bud, or folded; abaxial and adaxial surfaces both glabrous; margins glabrous. Cauline leaf blades (emerging from stolons) 4.0–9.8 mm long, 0.2–0.5 mm wide. Inflorescence not observed at Alert.

Characteristics allowing to distinguish *P. phryganodes* subsp. *neoarctica* from the other *Puccinellia* species present on Ellesmere Island can be found under *P. angustata*.

***Puccinellia vahliana* (Liebmann) Scribner & Merrill**
Figure 11L

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°26′38″N, 062°11′23″W; 178 m a.s.l.; 23 Jul. 2019; habitat: mesic, with polygonal patterned ground made of till, dominated by *Alopecurus magellanicus*; QFA0635523 • same locality; 82°31′13″N, 062°14′26″W; 10 m a.s.l.; 3 Aug. 2019; habitat: mesic in a slope, with till and rocks as substrates, dominated by *Salix arctica*; QFA0635524 • same locality; 82°27′33″N, 61°58′45″W; 120 m a.s.l.; 6 Aug. 2019; habitat: mesic, with till and rocks as substrates, dominated by *Alopecurus magellanicus* and moss; QFA0635531 • same locality; 82°27′29″N, 062°08′34″W; 155 m a.s.l.; 6 Aug. 2019; habitat: wetland, with peat, till, and rocks as substrates, dominated by *Alopecurus magellanicus* and moss; QFA0635532.

Identification. Plants 7.0–17.5 cm high; herbaceous; caespitose. Fibrous roots present. Stems 4.0–14.5 cm long; erect or ascending; glabrous. Leaves basal and cauline. Sheath margins glabrous. Ligules 1.8–2.7 mm long. Basal leaf blades 11–33 mm long, 0.4–0.7 (1.0–1.7 flat) mm wide; linear; rolled in bud or folded; abaxial and adaxial surfaces both glabrous; margins glabrous. Flag leaf blades 3.3–20.0 mm long, 0.25–0.80 (1.1–1.3 flat) mm wide. Inflorescence a dense panicle; 25–45 mm long. Branches at lowest inflorescence node 2–3; 1.0–6.3 mm long. Pedicels glabrous. Spikelets 3.5–5.8 mm long, 1.2–2.5 mm wide. Florets per spikelet 2 or 3. First glumes 1.5–2.9 mm long; lanceolate; surface glabrous; margins glabrous or scabrous; apices acute. Second glumes 2.1–3.6 mm long (shorter than, or almost as long as, the

lowest floret); ovate; veins 1–3; surface glabrous; margins glabrous or scabrous; apices acute. Lemmas 2.4–4.2 mm long, 0.5–0.9 mm wide; lanceolate; rounded on the back and with straight lemma tips; veins 3; surface dull, glabrous, and hairy, with hairs on and between the veins proximally; apices acute or erose, and glabrous; awnless. Palea 2.7–3.7 mm long; veins hairy proximally, with simple curly hairs, and scabrous apically. Rachilla between first and second lemmas 0.7–1.4 mm long. Androecium with 3 stamens and 0.8–1.8 mm long anthers. Gynoecium with 2 styles.

Characteristics allowing to distinguish *P. vahliana* from the other *Puccinellia* species present on Ellesmere Island can be found under *P. angustata*.

×*Pucciphippsia vacillans* (T. Fries) Tzvelev

Figure 11M

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°26′40″N, 062°43′09″W; 210 m a.s.l.; 14 Jul. 2019; habitat: mesic, with peat and till as substrates, dominated by *Juncus biglumis*, moss, and blue-green algae (macroscopic sheet colonies dominated by *Nostoc* sp.); QFA0635516, CAN • same locality; 82°27′49″N, 062°34′42″W; 126 m a.s.l.; 25 Jul. 2019; habitat: wetland, with tussocks made of peat and till, dominated by *Eriophorum triste*, *Arctagrostis latifolia*, and *Alopecurus magellanicus*; QFA0635588.

Identification. Plants 3.5–13.0 cm high; herbaceous; caespitose. Fibrous roots present. Stems 1–10 cm long; erect, ascending, or semi-prostrate; glabrous. Leaves basal and cauline. Sheath margins glabrous. Ligules 0.9–1.3 mm long. Basal leaf blades 25–60 mm long, 0.7–1.1 mm wide; linear; folded or rolled in bud; abaxial and adaxial surfaces both glabrous; margins glabrous. Flag leaf blades 12–15 mm long, 0.9–1.1 mm wide. Inflorescence a dense or diffuse panicle; 18–35 mm long. Branches at lowest inflorescence node 4–6; 2–10 mm long. Pedicels glabrous. Spikelets 2.2–2.5 mm long, 0.8–1.2 mm wide. Florets per spikelet 1–3. First glumes 0.5–0.7 mm long; ovate; surface glabrous; margins glabrous; apices obtuse. Second glumes 0.8–1.1 mm long (shorter than the lowest floret); ovate; veins 1–3; surface glabrous; margins glabrous; apices obtuse. Lemmas 2.0–2.3 mm long, 0.6–0.8 mm wide; lanceolate; rounded on the back; veins 3; surface dull, glabrous, and hairy, with hairs on and between the veins proximally; apices acute or erose, and glabrous; awnless. Palea 2.0–2.2 mm long; veins hairy. Rachilla between first and second lemmas 0.4–0.7 mm long. Androecium with 3 stamens and 0.7–1.2 mm long anthers. Gynoecium with 2 styles. Fruit not seen at Alert.

Characteristics allowing to distinguish ×P. *vacillans* from *Phippsia* can be found under *P. algida*.

Polygonaceae – Buckwheat family

Bistorta vivipara (Linnaeus) Delarbre

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°28′14″N, 062°24′04″W; 112 m a.s.l.; 9 Aug. 2019; habitat: wetland, with peat and till as substrates, dominated by *Eriophorum triste*, *Alopecurus magellanicus*, moss, and blue-green algae (macroscopic sheet colonies dominated by *Nostoc* sp.); QFA0635578.

Identification. Plants 4.0–7.5 cm high; herbaceous; not caespitose. Fibrous roots and rhizomes present. Stems 2.5–5.0 cm long; erect; glabrous. Leaves basal and cauline; heterophyllous; alternate; petiolate. Petioles 1–20 mm long; glabrous; adnate, with ocrea. Basal leaf blades 11–34 mm long, 3–6 mm wide; lanceolate or elliptic; bases attenuate or cuneate; abaxial surface hairy, with hyaline non-glandular hairs; adaxial surface shiny and glabrous; margins slightly revolute and glabrous; apices acute. Cauline leaf blades 5–18 mm long, 1–3 mm wide. Inflorescences a spike, with sessile bulbils throughout or with sessile bulbils proximally and 1–4 pedicellate flowers apically; 14–28 mm long. Bulbils 1.5–2.7 mm long, 1.0–1.7 mm wide; pyriform; reddish-purple or dark purple; surface glabrous. Tepals 5; 1.5–2.1 mm long, 0.7–1.4 mm wide; petaloid; obovate; white or pink. Androecium with 5–8 stamens and 0.2–0.3 mm long anthers. Gynoecium with 3 styles and 1 stigma per style. Fruit not observed at Alert.

Oxyria digyna (Linnaeus) Hill

Figure 13A–C

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°31′03″N, 062°26′20″W; 58 m a.s.l.; 2 Jul. 2019; habitat: barren ground near a river, with till and rocks as substrates; QFA0635579.

Identification. Plants 2.5–7.0 cm high; herbaceous; caespitose. Fibrous roots and rhizomes present. Stems 0.5–5.0 cm long; erect; glabrous. Leaves basal; alternate; petiolate. Petioles 8–16 mm long; glabrous; adnate, with ocrea. Basal leaf blade 5–18 mm long, 5–20 mm wide; reniform or orbicular; bases cordate; thick; green or reddish; abaxial and adaxial surfaces both glabrous; margins glabrous; apices rounded. Inflorescences a racemiform or paniculiform cyme, with ≥30 pedicellate flowers; 16–40 mm long. Tepals 4; 1.8–2.3 mm long, 1–2 mm wide; sepaloid; obovate or oblanceolate; green, red, or pink. Androecium with 5–7 stamens and 1.0–1.3 mm long anthers. Gynoecium with 2 styles and 1 stigma per style. Fruit an achene; 2.5–4.5 mm long, 2.5–3.5 mm wide; ovoid; winged; yellowish green to red; glabrous.

Ranunculaceae – Buttercup family

Ranunculus hyperboreus Rottbøll

Syn.: *Ranunculus hyperboreus* subsp. *hyperboreus*

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°26′26″N, 062°01′49″W; 147 m a.s.l.; 23 Jul. 2019; habitat: wetland on the margins of a lake, with peat as substrate, dominated by moss and *Luzula nivalis*; QFA0634991.

Identification. Plants 0.5–2.0 cm high; herbaceous; not caespitose. Fibrous roots and stolons (floating on

water) present. Stems 0.8–1.8 cm long; floating on water or creeping; rooting at nodes; glabrous. Leaves basal and cauline; isomorphic; alternate; petiolate. Petioles 4–25 mm long; glabrous. Leaf blades 3–10 mm long, 2–7 mm wide; flabellate; bases cuneate or obtuse, lobed, with 3 main linear or oblong-ovate, obtuse or rounded lobes (sometimes with second lobes); abaxial and adaxial surfaces both glabrous; margins entire or crenulate and glabrous. Inflorescence a solitary flower. Sepals 3 or 4; 1.8–3.0 mm long, 1.5–3.0 mm wide; ovate or obovate; pale brown or yellow; surface glabrous; margins glabrous; apices rounded. Petals 3 or 4; 2.0–3.5 mm long, 1.5–3.0 mm; obovate; unlobed; yellow. Androecium with 8–10, 0.5–0.8 mm long stamens. Receptacle 1–3 mm high; surface glabrous.

Among the eight *Ranunculus* Linnaeus species present on Ellesmere Island (*R. arcticus* Richardson, *R. aquatilis* Linnaeus, *R. hyperboreus*, *R. nivalis* Linnaeus, *R. pygmaeus* Wahlenberg, *R. sabinei* R. Brown, *R. subrigidus* W.B. Drew, *R. sulphureus* Solander; Aiken et al. 2007; GBIF 2020), only *R. aquatilis*, *R. hyperboreus*, and *R. subrigidus* are aquatic or amphibious plants with stems creeping or floating on water and rooting at nodes (in constrat to terrestrial or paludal plants with stems

Figure 13. Polygonaceae. **A.** *Oxyria digyna* (Linnaeus) Hill small plant habit, **B.** tall plant habit, and **C.** fruits. Photos A by Audrey Le Pogam, B by Émilie Desjardins, and C by Sandra Lai.

erect or if decumbent, rooting only at base; Whittemore 1997; Aikens et al. 2007). However, *R. aquatilis* and *R. subrigidus* are distinctive by having at least some leaves dissected into filiform segments. As for *R. hyperboreus*, it has reniform, lobed leaf blades (Aiken et al. 2007). In addition, *R. hyperboreus* has yellow petals, whereas the two others have petals that are white or white with yellow claws (Whittemore 1997).

Ranunculus sabinei R. Brown

Figure 14A

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°27′54″N, 062°46′43″W; 14 m a.s.l.; 8 Jul. 2019; habitat: wetland surrounded by hills, with silty sand as substrate, dominated by *Alopecurus magellanicus*; QFA0634990.

Identification. Plants 3–7 cm high; herbaceous; not caespitose. Fibrous roots present. Stems 2.5–6.0 cm long; erect or ascending; hairy, with hyaline hairs. Leaves basal and cauline; heterophyllous; alternate; petiolate (basal leaves) or sessile (cauline leaves). Petioles 5–14 mm long; glabrous. Basal leaf blades 6–10 mm long, 4–11 mm wide; widely depressed ovate or suborbicular; bases cuneate, obtuse, or truncate; lobed, with 3–5 main palmate, obtuse lobes; abaxial surface glarous or sparsely hairy, with hyaline hairs; adaxial surface glabrous; margins ciliate. Cauline leaf blades 6–9 mm long, 5–8 mm wide; lobed, with 3 deeply cleft, linear, obtuse lobes; abaxial surface glabrous; adaxial surface glabrous or sparsely hairy, with hyaline hairs; margins ciliate. Inflorescence a solitary flower. Sepals 5; 4–7 mm long, 2.0–3.5 mm; lanceolate, ovate, or obovate; pale brown or pinkish-brown, with hyaline margins; surface hairy, with hyaline hairs; margins glabrous or hairy; apices rounded or obtuse. Petals 5; 4–7 mm long, 2–4 mm wide; obovate; unlobed; yellowish-purple. Androecium with 20–30, 2.0–3.3 mm long stamens. Receptacle 3–6 mm high; surface glabrous or sparsely hairy, with hyaline hairs. Fruit an achene; 0.9–1.4 mm long, 0.7–1.0 mm wide; ovoid; yellowish-green; with curved beak; glabrous.

Ranunculus sabinei is similar to *R. arcticus* and *R. pygmaeus*, both of which are found on Ellesmere Island, by having white or translucent hairs on sepals, but differ in the following characters: leaf blades of *R. sabinei* and *R. pygmaneus* are usually 3-lobed, whereas they are 5- to 9-lobed in *R. arcticus*; sepals of *R. sabinei* are bigger (4–7 mm long, 2–3 mm wide) than those of *R. pygmaeus* (2–4 mm long, 1.2–1.6 mm wide); and petals of *R. sabinei* are longer (5–8 mm long) than those of *R. pygmaeus* (1.2–3.5 mm long) but shorter than those of *R. arcticus* (7–15 mm long; Saarela et al. 2020).

Ranunculus sulphureus Solander

Figure 14B

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°25′52″N, 062°07′49″W; 296 m a.s.l.; 16 Jul. 2019; habitat: wetland in a mountain pass, with peat and rocks as substrates, dominated by moss and *Saxifraga cernua*; QFA0634989.

Figure 14. Ranunculaceae. **A.** *Ranunculus sabinei* R. Brown habit. **B.** *Ranunculus sulphureus* Solander fruits. Photos A by Émilie Desjardins and B by Jacob Caron Carrier.

Identification. Plants 4.0–13.5 cm high; herbaceous; caespitose or not caespitose. Fibrous roots present. Stems 3.2–11.0 cm long; erect or ascending; glabrous proximally and hairy apically, with brown hairs. Leaves basal and cauline; heterophyllous; alternate; petiolate (basal leaves) or sessile (cauline leaves). Petioles 8–25 mm long; hairy. Basal leaf blades 5–15 mm long, 8–16 mm wide; widely depressed ovate or suborbicular; bases cuneate or truncate; lobed, with 3–5 main palmate, obtuse lobes; abaxial and adaxial surfaces both either glabrous or sparsely hairy, with brown hairs; margins ciliate. Cauline leaf blades 5–15 mm long, 6–18 mm wide; palmatisect, with 3–5 linear, obtuse lobes; abaxial and adaxial surfaces both either glabrous or sparsely hairy, with brown hairs; margins ciliate. Inflorescence a solitary flower. Sepals 5; 3–6 mm long, 3–4 mm wide; ovate or obovate; yellowish-brown; surface hairy, with brown hairs; margins ciliate; apices rounded. Petals 5; 4–9 mm long, 3–7 mm wide; obovate; unlobed; yellow. Androecium with 20–30, 1.2–2.0 mm long stamens. Receptacle 3.5–7.0 mm high; surface hairy, with brown hairs. Fruit an achene; 1.5–3.0 mm long, 1.0–1.7 mm wide; ovoid; yellowish-green; with straight or curved beak; glabrous.

Ranunculus sulphureus and *R. nivalis* have brown hairs on sepals in contrast to pubescent with white hairs or glabrous sepals found in the six other *Ranunculus* species present on Ellesmere Island (*R. arcticus*, *R. aquatilis*, *R. hyperboreus*, *R. pygmaeus*, *R. sabinei*, and *R. subrigidus*; Aiken et al. 2007; GBIF 2020). The two species can be differentiated by the following: the basal leaf blades are shallowly lobed in *R. sulphureus*, whereas they are 3-parted in *R. nivalis*; and the receptacles are hairy in *R. sulphureus* and glabrous in *R. nivalis* (Saarela et al. 2020).

Rosaceae – Rose family

Dryas integrifolia* Vahl subsp. *integrifolia
Figure 15A–C

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°28′34″N, 062°26′49″W; 128 m a.s.l.; 2 Jul. 2019; habitat: barren ground, with till and rocks as substrates, and sparse dominance of *Saxifraga oppositifolia*; QFA0635001.

Identification. Plants 3–8 cm high; dwarf shrubs. Taproots and rhizomes present. Branches prostrate, sometimes rooting at nodes. Leaves evergreen; basal and cauline; isomorphic; alternate; petiolate. Stipules green or brown; hairy. Petioles 2–5 mm long; hairy, with white hairs. Leaf blades 4–9 mm long, 1–3 mm wide; lanceolate; bases cordate or truncate; unlobed; abaxial surface tomentose, with white hairs; adaxial surface shiny dark green, glabrous or sparsely hairy on the midvein; margins entire or slightly crenate, revolute, and glabrous; apices acute. Inflorescence a solitary flower. Pedicels 15–25 mm long; erect; hairy with woolly hyaline hairs and dark purple glandular hairs. Epicalyx absent. Sepals 7 or 8; 3–7 mm long, 1–2 mm wide; linear or lanceolate; dark green; surface hairy, with woolly hyaline hairs and dark purple glandular hairs; margins ciliate; apices acute. Petals 8; 7–11 mm long, 3–5 mm wide; obtrullate or obovate; unlobed; white or ivory. Androecium with 40–70 stamens and 0.5–0.9 mm long anthers. Gynoecium consisting of numerous separate carpels, with 5–6 mm long conical styles. Fruit an achene, with elongate plumose styles.

***Potentilla pulchella* R. Brown**
Figure 15D, E

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°28′04″N, 062°51′28″W; 31 m a.s.l.; 9 Jul. 2019; habitat: xeric in a slope, with till and rocks as substrates, dominated by *Salix arctica* and *Dryas integrifolia*; QFA0635000.

Identification. Plants 2.0–4.5 cm high; herbaceous; caespitose. Taproot and rhizomes present. Stems 2.0–5.5 cm long; ascending, decumbent, or prostrate; hairy, with non-glandular hairs. Leaves basal and cauline; heterophyllous; petiolate. Stipules green or reddish-brown; hairy. Petioles 5–28 mm long; hairy, with white non-glandular hairs. Basal leaf blades 10–25 mm long, 10–22 mm wide; pinnate-compound, with 3–5 pinnatisect leaflets distributed along the lower ⅔ of leaf axis. Leaflet blades 6–16 mm long, 4–9 mm wide; obovate; lobed, with 3–7 lanceolate, obtuse lobes; abaxial and adaxial surfaces both hairy, with white long–silky, non-glandular hairs (sometimes adaxial surface glabrate with few hairs); margins revolute and ciliate. Cauline leaf blades simple or ternate-compound. Inflorescence a solitary flower or a cyme, with 2 or 3 flowers. Epicalyx 1–3 mm long, 0.5–1.0 mm wide; oblanceolate. Sepals 5; 3–6 mm long, 2–3 mm wide; ovate; green; surface hairy, with hyaline non-glandular hairs; margins ciliate; apices acute. Petals 5; 3–6 mm long, 2–3 mm wide; obovate; unlobed, slightly lobed, or undulating; yellow. Androecium with 17–22 stamens and 0.4–0.6 mm long anthers. Gynoecium consisting of numerous separate carpels, with 0.9–1.2 mm long conical styles.

Potentilla pulchella can be distinguished from the nine other *Potentilla* Linnaeus species present on Ellesmere Island (GBIF 2020) by the pinnate leaves (in contrast to ternate or palmate leaves in *P. arenosa* (Turczaninow) Juzepczuk subsp. *arenosa* and subsp. *chamissonis* (Hultén) Elven & D.F. Murray, *P. hyparctica* Malte subsp. *hyparctica* and subsp. *elatior* (Abromeit) Elven & D.F. Murray, *P. nivea* Linnaeus, *P. subgorodkovii* Jurtzev, *P. tikhomirovii* Jurtzev, *P. vahliana* Lehmann, and *P. vulcanicola* Juzepczuk; Ertter et al. 2014); the pinnate leaflets distributed along the ⅙–½ and more of the leaf axis (in contrast to ⅙–¼ of the leaf axis in *P. pedersenii* (Rydberg) Rydberg and *P. rubricaulis* Lehmann; Ertter et al. 2014); and the ≤3 mm wide petals (in contrast to all other *Potentilla* species present on Ellesmere Island, which have ≥3 mm wide petals; Ertter et al. 2014).

At Alert, *P. pulchella* is highly polymorphic in terms of hairiness. Most individuals have silvery-white appearance due to dense hairs on leaves, whereas few individuals are sparsely hairy (Fig. 15D, E). A molecular study of this species on Svalbard has shown that there is nearly no genetic (RAPD) variation among subpubescent and pubescent plants (Hansen et al. 2000). Instead, pubescence variation is phenotypic and is associated with different abiotic conditions: pubescent plants growing on cliffs, ridges, scree slopes, and silt shore terraces, and subpubescent plants on gravel shore terraces (Hansen et al. 2000).

Salicaceae – Willow family

***Salix arctica* Pallas**
Figure 16A–C

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°29′43″N, 61°57′15″W; 14 m a.s.l.; 30 Jul. 2019; habitat: xeric in a slope, with till and rocks as substrates, and sparse dominance of *Salix arctica*; QFA0635521.

Identification. Plants 2–5 cm high; dwarf shrubs. Fibrous roots present. Branches erect, decumbent, or

Figure 15. Rosaceae. **A.** *Dryas integrifolia* Vahl subsp. *integrifolia* habit, **B.** flower, and **C.** fruits. **D.** *Potentilla pulchella* R. Brown subpubescent plant habit and **E.** pubescent plant habit. Photos A by Audrey Le Pogam, B, D by Émilie Desjardins, C by Francis Robitaille, and E by Charline Couchoux.

trailing; glabrous. Branchlets glabrous or hairy, with long hyaline hairs. Leaves deciduous; cauline; alternate; petiolate. Stipules 1.3–1.5 mm long; green; deciduous. Petioles 1.1–4.9 mm long; glabrous or hairy. Cauline leaf blades 5.6–19.5 mm long, 2.5–7.5 mm wide; elliptic, oblanceolate, or obovate; bases obtuse, cuneate, or rounded; green; abaxial surface glaucous and hairy, with long hyaline hairs; adaxial surface dull or shiny, and glabrous or sparsely hairy, with long hyaline hairs; margins entire, flat, and ciliate; apices obtuse or acute. Inflorescences catkins. Plants dioecious. Peduncles hairy. Staminate catkins 14–25 mm long, 6–10 mm wide. Pistillate catkins 10–30 mm long, 8–14 mm wide; Bracteoles 0.8–1.6 mm long, 1.0–1.2 mm wide; reddish-brown or black; surface hairy, with white hairs; apices rounded or obtuse. Androecium with 2 stamens and 0.3–0.5 mm

long anthers. Gynoecium with hairy (white hairs) pyriform ovaries (2.2 mm long, 1 mm wide), 1.1–1.3 mm long styles, and 0.3–0.6 mm long stigma lobes.

Salix arctica and *S. arctophila* Cockerell ex A. Heller are the only *Salix* Linnaeus species present on Ellesmere Island (GBIF 2020) and can be distinguished based on the following: the largest medial leaf blade abaxial surface is glabrous in *S. arctophila*, whereas it is usually pilose in *S. arctica* (sometimes the midrib is sparsely short-silky and the apex is long-silky bearded; Saarela et al. 2020); leaf blade margins are serrulate or crenulate (sometimes entire) in *S. arctophila*, whereas the margins are entire in *S. arctica* (Saarela et al. 2020); and the ovary hairs are white and rust-couloured, appressed, crinkled, and ribbon-like in *S. arctophila*, whereas the hairs are only white, flattened, and wavy (not crinkled) in *S. arctica* (Aiken et al. 2007).

Saxifragaceae – Saxifrage family

Micranthes tenuis (Wahlenberg) Small

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°25′52″N, 062°07′49″W; 296 m a.s.l.; 16 Jul. 2019; habitat: wetland in a mountain pass, with peat and rocks as substrates, dominated by moss and *Saxifraga cernua*; QFA0634988.

Identification. Plants 3–6 cm high; herbaceous; not caespitose. Fibrous roots present. Stems 1.9–5.0 cm long;

Figure 16. Salicaceae. **A.** *Salix arctica* Pallas female catkin habit, **B.** male flowers, and **C.** male catkin habit. Photos A, B by Émilie Desjardins and C by Audrey Le Pogam.

erect; hairy, with septate glandular hairs (0.1–0.5 mm long). Leaves basal; patent or horizontal; alternate; petiolate. Petioles 0.5–3.0 mm long; hairy, with septate glandular hairs. Basal leaf blades 4–10 mm long, 3–7 mm wide; obovate or obtrullate; bases cuneate or attenuate; lobed, with 5–10 triangular, obtuse lobes; green or reddish-purple; abaxial and adaxial surfaces both glabrous; margins glabrous or ciliate, with septate glandular hairs. Inflorescence a solitary flower or a capitate cyme, with 2–5 flowers. Bracts 3–5 mm long, 1.2–2.5 mm wide; ovate or lanceolate; surface glabrous; margins ciliate. Pedicels hairy. Sepals 5; 3–5 mm long, 1.5–2.5 mm wide; elliptic or obovate; green to purple; surface glabrous; margins glabrous; apices obtuse or rounded. Petals 5; 2.5–4.0 mm long, 0.8–2.0 mm wide; obovate; unlobed; pink. Androecium with 8–10 stamens and 0.2–0.4 mm long anthers. Gynoecium with 2 styles.

Four *Micranthes* Hawort species are present on Ellesmere Island (GBIF 2020). *M. hieraciifolia* (Waldstein & Kitaibel ex Willdenow) Haworth, *M. nivalis* (Linnaeus) Small, and *M. tenuis* have inflorescences without bulbils, in contrast to *M. foliolosa* (R. Brown) Gornall, which has bulbils replacing some or all the flowers (Saarela et al. 2020). The inflorescences, however, differ among the first three species; *M. hieraciifolia* has spikelike thyrses 2–10 cm long, whereas *M. nivalis* and *M. tenuis* have capitate thyrses or capitate cymes 0.5–4.0 cm long (Saarela et al. 2020). *Micranthes tenuis* is similar to *M. nivalis* but the two differ in a few characters: *M. tenuis* has more slender stems with sparse hairs <1 mm long, whereas stems of *M. nivalis* are pubescent with hairs >1 mm long (Blondeau 2015c); the inflorescence of *M. tenuis* is a solitary flower or an open capitate cyme with 2–10 distinctly pedicellate flowers, whereas inflorescence of *M. nivalis* is a compact capitate thyrse with 5–40 densely clustered flowers (Aiken et al. 2007; Brouillet and Elvander 2009a). Moreover, *M. nivalis* is mostly found in barren grounds and hummocks, whereas *M. tenuis* is only found in wet and moist areas such as pond margins, wet meadows, and marshes (Aiken et al. 2007).

Saxifraga cernua Linnaeus

Figure 17A, B

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°25′52″N, 062°07′49″W; 296 m a.s.l.; 16 Jul. 2019; habitat: wetland in a mountain pass, with peat and rocks as substrates, dominated by moss and *Saxifraga cernua*; QFA0635006.

Identification. Plants 4–11 cm high; herbaceous; not caespitose. Fibrous roots present. Stems 3.5–10.0 cm long; erect or ascending; hairy, with septate glandular hairs. Leaves basal and cauline; heterophyllous; alternate; petiolate (basal and lower cauline leaves) or sessile (upper cauline leaves). Petioles 3–25 mm long; glabrous or hairy, with septate glandular hairs. Basal leaf blades 3–8 mm long, 3–11 mm wide; suborbicular or transversely elliptic; bases cuneate, truncate, or cordate; lobed, with 3–5 palmate, obtuse or acute lobes; green or reddish-purple; abaxial and adaxial surfaces both glabrous; margins glabrous or ciliate. Cauline leaf blades 2–10 mm long, 1–12 mm wide; ovate or lanceolate; unlobed or lobed, with 3–5 palmate lobes; abaxial surface hairy proximally, with septate glandular hairs; adaxial surface glabrous; margins glabrous or ciliate, with septate glandular hairs. Bulbils in cauline leaf axils 1–3 mm long; dark red. Inflorescence a solitary flower. Sepals 5; 2.5–4.0 mm long, 2–3 mm wide; ovate; reddish-purple; surface hairy, with septate glandular hairs; margins ciliate; apices obtuse. Petals 5; 5–10 mm long, 4–6 mm wide; obovate; unlobed or slightly notched; white or ivory. Androecium with 8–10 stamens and 0.7–1.8 mm long anthers. Gynoecium with 2 styles.

Among the nine *Saxifraga* Linnaeus species present on Ellesmere Island (*S. aizoides* Linnaeus, *S. flagellaris* Willdenow subsp. *platysepala* (Trautvetter) A.E. Porsild, *S. hirculus* Linnaeus, *S. oppositifolia* Linnaeus, *S. cernua*, *S. cespitosa* Linnaeus, *S. hyperborea* R. Brown, *S. rivularis* Linnaeus, and *S. tricuspidata*; GBIF 2020), only the five first species have toothed or lobed basal leaves with white, pale yellow, or purplish white petals (Aiken et al. 2007; Saarela et al. 2020). Among them, only *S. cernua* has bulbils (Aiken et al. 2007; Saarela et al. 2020). *S. cespitosa* has hairy adaxial leaf blade surface and hairy calyx, whereas these two sructures are glabrous in *S. hyperborea*, *S. rivularis*, and *S. tricuspidata* (Aiken et al. 2007). In addition, *S. cespitosa* and *S. tricuspidata* have sessile basal leaves, whereas *S. hyperborea* and *S. rivularis* have distinctly petiolate basal leaves (Saarela et al. 2020). Basal leaf blades are sharply 3-toothed in *S. tricuspidata*, whereas *S. hyperborea* and *S. rivularis* have basal leaf blades with 2–7 rounded or obtuse lobes (Brouillet and Elvander 2009b). The petals are also spotted in *S. tricuspidata* but not in *S. cernua*, *S. cespitosa*, *S. flagellaris* subsp. *platysepala*, *S. hyperborea*, *S. oppositifolia*, and *S. rivularis* (Aiken et al. 2007; Brouillet and Elvander 2009b)

Saxifraga cespitosa Linnaeus

Figure 17C, D

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°26′39″N, 61°57′18″W; 159 m a.s.l.; 26 Jul. 2019; habitat: mesic, with till and rocks as substrates, dominated by *Juncus biglumis*, moss, and lichen; QFA0635005.

Identification. Plants 2.5–7.0 cm high; herbaceous; caespitose (cushion shape). Taproots and rhizomes present. Stems 1.5–6.0 cm long; erect or ascending; hairy, with glandular hairs. Leaves basal and cauline; heterophyllous; alternate; petiolate (basal leaves) or sessile (cauline leaves). Petioles 2–15 mm long; hairy, with glandular hairs. Basal leaf blades 3–7 mm long, 3–6 mm wide; oblanceolate or obtrullate; bases cuneate; lobed, with 3 linear or lanceolate, obtuse lobes; reddish-purple; abaxial surface sparsely hairy, with glandular hairs; adaxial surface glabrous; margins ciliate. Cauline leaf blades 3–6 mm long, 1 mm wide; linear or elliptic; abaxial

Figure 17. Saxifragaceae. **A.** *Saxifraga cernua* Linnaeus flowers and **B.** habit. **C.** *Saxifraga cespitosa* Linnaeus habit and **D.** fruit-forming. **E.** *Saxifraga flagellaris* Willdenow subsp. *platysepala* (Trautvetter) A.E. Porsild habit. **F.** *Saxifraga oppositifolia* Linnaeus subsp. *oppositifolia* habit. **G.** *Saxifraga tricuspidata* Rottbøll habit. Photos A, D by Francis Robitaille, B, E by Audrey Le Pogam, C by Émilie Desjardins, F by Sandra Lai, and G by Alan Mott.

and adaxial surfaces both sparsely hairy, with glandular hairs; margins ciliate. Inflorescence a solitary flower or a cyme, with 2 or 3 flowers. Pedicels hairy. Sepals 5; 4.0–5.5 mm long, 0.5–2.5 mm wide; ovate or lanceolate; purplish green or reddish-purple; surface hairy, with glandular hairs; margins ciliate; apices obtuse or rounded. Petals 5; 3.0–5.8 mm long, 1.2–2.5 mm wide; oblanceolate or obovate; unlobed; pale yellow. Androecium with 9–10 stamens and 0.3–0.8 mm long anthers. Gynoecium with 2 styles.

Characteristics allowing to distinguish *S. cespitosa* from the other *Saxifraga* species present on Ellesmere Island can be found under *S. cernua*.

***Saxifraga flagellaris* Willdenow subsp. *platysepala* (Trautvetter) A.E. Porsild**

Figure 17E

Materials examined. CANADA – **Nunavut** • Ellesmere

Island, CFS Alert; 82°27′17″N, 062°35′55″W; 166 m a.s.l.; 11 Jul. 2019; habitat: mesic in a slope; QFA0635003.

Identification. Plants 1.5–6.0 cm high; herbaceous; not caespitose. Fibrous roots and stolons present. Stolons 25–80 mm long; filiform; red; hairy, with glandular hairs; leafless; terminating in a tiny rosette attached to the substrate by adventitious roots. Stems 1.0–5.5 cm long; erect; hairy, with glandular hairs. Leaves basal and cauline; heterophyllous; alternate; subsessile (basal leaves) or sessile (cauline leaves). Basal leaf blades 3–8 mm long, 2.0–4.5 mm wide; obovate or obtrullate; unlobed; red or green; abaxial and adaxial surfaces both glabrous; margins ciliate, with long stiff glandular hairs; apices obtuse. Cauline leaf blades 4–6 mm long, 1–2 mm wide; abaxial surface sparsely hairy, with glandular hairs; adaxial surface glabrous; margins ciliate; apices rounded or obtuse. Inflorescence a solitary flower. Sepals 5; 3–6 mm long, 1.5–2.5 mm wide; ovate; green to purple; surface hairy, with glandular hairs; margins ciliate; apices obtuse. Petals 5; 4–10 mm long, 2.5–6.0 mm wide; obovate; unlobed; yellow. Androecium with 9–10 stamens and 0.5–0.9 mm long anthers. Gynoecium with 2 styles. Fruit not seen at Alert.

Among the three *Saxifraga* species present on Ellesmere Island with entire basal leaves and yellow petals (*S. aizoides*, *S. flagellaris* subsp. *platysepala*, and *S. hirculus*; GBIF 2020; Saarela et al. 2020), *S. flagellaris* subsp. *platysepala* differs from the two others by having red, long stolons and unspotted petals (Saarela et al. 2020). *S. aizoides* and *S. hirculus* usually do not have stolons (but if present, the stolons are very short and green), but can have petals with orange spots (Saarela et al. 2020).

Saxifraga oppositifolia Linnaeus subsp. *oppositifolia*

Figure 17F

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°29′43″N, 61°57′15″W; 14 m a.s.l.; 30 Jul. 2019; habitat: xeric in a slope, with till and rocks as substrates, and sparse dominance of *Salix arctica*; QFA0635002.

Identification. Plants 1.5–3.0 cm high; herbaceous; caespitose (cushion shape) or not caespitose (trailing shape). Taproots and rhizomes present. Stems 1–6 cm long; prostrate, decumbent, or ascending; hairy, with non-glandular hairs. Leaves cauline; sometimes overlapping or imbricate; decussate; subsessile. Cauline leaf blades 2–5 mm long, 1.0–4.5 mm wide; obovate or obtrullate; bases cuneate; unlobed; green; abaxial and adaxial surfaces both glabrous; margins ciliate, with non-glandular hairs; apices rounded, obtuse, or truncate. Inflorescence a solitary flower. Sepals 5; 2.5–5.0 mm long, 1.6–2.5 mm wide; ovate; purple; surface glabrous or hairy, with non-glandular hairs; margins ciliate; apices obtuse. Petals 5; 4–8 mm long, 3–5 mm wide; obovate; unlobed; purple, pink, or white. Androecium with 9 or 10 stamens and 0.2–0.6 mm long anthers. Gynoecium with 2 styles. Fruit a capsule.

Saxifraga oppositifolia differs from all other *Saxifraga* species present on Ellesmere Island by having purple or pink petals (Aiken et al. 2007; Saarela et al. 2020).

Saxifraga tricuspidata Rottbøll

Figure 17G

Materials examined. CANADA – **Nunavut** • Ellesmere Island, CFS Alert; 82°26′39″N, 61°57′18″W; 159 m a.s.l.; 26 Jul. 2019; habitat: mesic, with till and rocks as substrates, dominated by *Juncus biglumis*, moss, and lichen; QFA0635004.

Identification. Plants 3.5–7.5 cm high; herbaceous; caespitose (cushion shape). Taproots and rhizomes present. Stems 2.5–7.0 cm long; erect; hairy, with glandular hairs. Leaves basal and cauline; heterophyllous; alternate; subsessile (basal leaves) or sessile (cauline leaves). Basal leaf blades 3–10 mm long, 1.5–4.0 mm wide; linear or oblanceolate; bases cuneate; lobed, with 1–3 triangular, cuspidate lobes; green or red; abaxial and adaxial surfaces both glabrous; margins ciliate, with non-glandular hairs. Cauline leaf blades 2.5–6.5 mm long, 0.5–1.5 mm wide; elliptic or oblanceolate; unlobed or sometimes lobed, with narrow triangular lobes; abaxial and adaxial surfaces both glabrous; margins ciliate, with non-glandular hairs; apices cuspidate. Inflorescence a cyme, with 2–7 flowers. Pedicels hairy. Sepals 5; 1.5–2.0 mm long, 0.8–1.5 mm wide; ovate; green or purple; surface glabrous; margins glabrous; apices obtuse. Petals 5; 2.5–5.0 mm long, 1–3 mm wide; obovate or oblanceolate; unlobed; ivory or yellow, with apically yellow, orange, or red dots. Androecium with 10 stamens and 0.3–0.7 mm long anthers. Gynoecium with 2 styles.

Characteristics allowing to distinguish *S. tricuspidata* from the other *Saxifraga* species present on Ellesmere Island can be found under *S. cernua*.

Discussion

The total of 58 species recorded during this survey (including 15 Arctic endemics) is a representative number of taxa for a polar desert ecosystem (Aleksandrova 1980; Bay 1992). This is also within the range of vascular plant species richness found in other areas on or near Ellesmere Island. For example, from south to north, 85 species were found at Alexandra Fiord (Muc et al. 1989), 40 in the central part of Ellesmere Island (Lévesque 1997), 75 at Sverdrup Pass (Bergeron and Svoboda 1989), 151 at Quttinirpaaq National Park (Parks Canada 1994), and 36 at Ward Hunt Island (Vincent et al. 2011). Part of the variation among surveys likely reflects the size of the surveyed area, as well as environmental conditions and landscape heterogeneity (e.g., topography, hydrology, substrate, and microclimate; Ravolainen et al. 2020; Taylor et al. 2020).

Among the 14 families recorded, the Poaceae (18 species) accounted for 32% of the inventoried vascular plant species. The predominance of this family is higher than in other High Arctic ecosystems, notably Ward Hunt

Island (11% with 4 Poaceae species; Vincent et al. 2011), North of Greenland (20% with 19 Poaceae species; Bay 1997), Svalbard (14% with 25 Poaceae species; Svalbard Flora 2020), and Cape Chelyuskin in Russia (22% with 10 Poaceae species; Matveyeva and Chernov 1976). Poaceae are early successional species in some Arctic ecosystems and they are most abundant within the first 20 years of colonization of a new environment, including bare soils and enriched or disturbed areas (Forbes and Jefferies 1999; Forbes et al. 2001; Cray and Pollard 2015). This relatively high diversity in Poaceae for a polar desert ecosystem may reflect perturbations related to land use, soil contamination, and operation of heavy vehicles on the soft ground during snowmelt in early summer near CFS Alert.

We recorded four species that were new for the Alert region, but that had been already reported on Ellesmere Island by other collectors (distance and direction from nearest previous records are indicated in parentheses): *Draba pauciflora* (Grant Land Mountain, ca. 40 km W; *Kershaw s.n.* (DAO6935)), *Festuca edlundiae* (Tanquary Fiord, ca. 300 km WSW; *Aiken 94-016E* (CAN10012792)), *Festuca hyperborea* (Lake Hazen, ca. 140 km WSW; *Sokoloff & McMullin 951* (CAN10064714)), and ×*Pucciphippsia vacillans* (Craig Harbour, ca. 790 km SSW; *Malte s.n.* (ALTA-VP33562)). For *Festuca edlundiae*, this record at Alert corresponds to an extension of the known northern distribution limit in the Canadian Arctic from 82°25′N to 82°31′N (GBIF 2020). Similarly, the record of the hybrid ×*Pucciphippsia vacillans* extends its known northern distribution limit from 76°12′N to 82°31′N in the Canadian Arctic (GBIF 2020). *Draba pauciflora* and *Festuca hyperborea* have been found previously at the same latitude or higher on Ellesmere Island (GBIF 2020). *Draba pauciflora* and *Festuca hyperborea* are rare and were found only in a few plots (one and five plots, respectively), which may explain why they had not been found previously. ×*Pucciphippsia vacillans* was more abundant (found in 20 plots), but they may have been mistaken for *Phippsia* sp. in the past. *Festuca edlundiae* was relatively recently separated from other known *Festuca* species (Aiken et al. 1995), and the re-identification of existing specimens from Alert may uncover more records of this species.

Despite our intensive systematic search, we did not find 21 species that had been previously recorded within the study area (GBIF.org 2020). It is possible they were located in microhabitats that we missed while focusing more on systematic than opportunistic sampling.

Taraxacum holmenianum (*Harington 50* (CAN 10085233)) was previously reported from Alert as *T. phymatocarpum* (Aiken et al. 2007); this specimen was redetermined as *T. holmenianum* by J.M. Saarela (Canadian Museum of Nature).

Draba alpina, *D. cinerea*, *D. fladnizensis*, and *D. nivalis* were all previously recorded for Alert by Bruggemann and Calder (1953). However, we were not able to access these records for confirmation in any online database or at the National Collection of Vascular Plants (DAO). *Draba lactea* and *D. oblongata* were not reported in the initial paper of Bruggemann and Calder (1953); they were since re-identified at DAO (*D. lactea*: *Bruggemann s.n.* (DAO08985) and (DAO08986)). However, we were not able to verify sheets of *D. oblongata* R. Brown ex de Candolle (*Bruggemann s.n.* (DAO10096) and (DAO10097); *Harington s.n.* (ALTA-VP9754)), reported in Aiken et al. (2007). *Draba simmonsii* was reported from the station by Elven and Al-Shehbaz (2008) as a paratype of this newly described High Arctic taxon. This specimen was previously determined as *D. alpina* (*MacDonald 37* (CAN10056945)). We did not encounter *D. simmonsii* in 2018–2019.

Neither *Cerastium alpinum* Linnaeus (Bruggemann and Calder 1953) nor *C. beeringianum* (*Harington 81* (CAN10046052)) were encountered during our 2019–2019 field seasons. *Cerastium alpinum* and *C. arcticum* were previously differentiated within a *C. alpinum–C. arcticum* complex or lumped into a widely defined *C. alpinum* (Hultén 1956; Böcher 1977; Brysting and Elven 2000). The identification of all three species is particularly problematic in the Arctic because they overlap in most characters and a combination of characters is required to differentiate them unambiguously (Brysting and Elven 2000). *Silene sorensenis* was previously recorded at Alert by Bruggemann and Calder (1953), MacDonald (*MacDonald 23* (CAN10047218)), and Harington (*Harington 112* (CAN10047213)). We did not encounter this taxon ourselves but accept the two species records at CAN based on examination of online specimen images.

Carex nardina Fries was not encountered in our 2018–2019 field seasons, but it was previously recorded twice at Alert (Bruggemann and Calder 1953; *Harington 32* (CAN10038316)).

Luzula confusa Lindeberg was likewise not collected during our 2018–2019 field season, but it was recorded by Harington during his study at Alert (*Harington 173* (CAN10041687); *Harington s.n.* (ALTA-VP4715)).

Papaver radicatum Rottbøll was recorded by Bruggemann and Calder (1953) and subsequent workers at the station, following earlier floristic treatments of the Canadian Arctic (Polunin 1940; Porsild 1957). Later works by Solstad (2009) and Solstad and Elven (unpublished data) on this circumpolar genus suggest that *P. radicatum* is a strictly northern European species and that there are five *Papaver* species present in the Canadian Arctic Flora. These previous collections of *P. radicatum* have since been re-identified to *P. cornwallisense* (*Harington 118* (CAN10052454), *Harington 167* (CAN10052470), *Johnson 09* (CAN10052474), *Johnson 104* (CAN10052472)) and *P. lapponicum* (*Johnson 15* (CAN10052488), *Johnson 89* (CAN10052487), *MacDonald 32* (CAN10052490), and *Pilon s.n.* (CAN10052493)). We did not encounter either of these two species during our 2018–2019 fieldwork.

Poa hartzii Gandoger subsp. *vrangelica* var. *vivipara* Polunin was recorded by Bruggemann and Calder (1953)

but not recollected by us. Bruggemann and Calder (1953) also recorded *Puccinellia pumila* (Vasey) Hitchcock at the station, which we suspect had been misidentified, since this species is usually found at much lower latitudes and is not currently recorded on Ellesmere Island (GBIF 2020). However, we were not able to verify the current status of this collection as most of the collections deposited by P.F. Bruggemann do not appear on the database of the National Collection of Vascular Plants (CBIF 2020), and we were unable to visit this herbarium.

Ranunculus subrigidus was recorded by Bruggemann and Calder (1953) and MacDonald (*MacDonald 26* (CAN10052073)). *Potentilla hyparctica* Malte was also recorded by Bruggemann and Calder (1953) and MacDonald (*MacDonald 48* (CAN10063302)). We did not record either species.

Micranthes nivalis was collected twice by MacDonald at Alert (*MacDonald 43* (CAN10061875); *MacDonald 45* (CAN210853)) but not recollected by us. Likewise, we did not encounter *Saxifraga hyperborea* R. Brown (previously identified as *Saxifraga rivularis* Linnaeus in *Harington 168* (CAN10089195)) in 2018–2019.

Based on this analysis of the floristic inventories from the last 70 years and by the exclusion of *Papaver radicatum* and *Puccinellia pumila*, we conclude that 77 vascular plant species are currently present in our study area at Alert.

An interesting observation is that we found *Poa pratensis* subsp. *colpodea* on a perching site used by birds of prey and on an arctic fox den. These faunal sites are productive vegetation patches due to the regular deposits of urine, faeces, casts, and prey remains, which release nutrients (Aiken et al. 2007; Gharajehdaghipour et al. 2016).

Our survey provides new information that contributes to biodiversity monitoring efforts and conservation management of vascular plants at Alert. In addition to being exposed to climatic warming (CAFF 2013), the vegetation at Alert may have already experienced direct anthropogenic disturbance, including habitat degradation from off-road use of military vehicles and soil contamination, due to past waste management issues. Introduction of new plant species through the transportation of personnel and heavy equipment at Alert may also provide opportunity for plant dissemination, although our survey revealed no obvious case of establishment of a non-native species. A better understanding of the above threats may be important regarding the imperiled *Festuca viviparoidea* subsp. *viviparoidea*, which has a scattered distribution and low occurrence in Nunavut (NatureServe 2020; GBIF 2020), and other arctic endemic species with restricted distribution (e.g., *Draba pauciflora*, *Festuca edlundiae*, and ×*Pucciphippsia vacillans*). In this context, identifying areas of highest conservation concerns is essential. The status of several Arctic species is currently not assessed and precise information on distribution and population trends is often lacking (CAFF 2013). Long-term monitoring of plant communities and regular surveillance for the establishment of non-native species are thus critical to assess the effects of climatic changes and anthropogenic impacts on High Arctic ecosystems. The relative accessibility of Alert to scientists offers invaluable opportunities to better understand High Arctic biodiversity and its ongoing changes.

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Authors' Contributions

ED, DB, FV and AT contributed to the study design; ED, DB, SL and MP collected the data; ED, SP, MD, PCS, AS, and LS identified the specimens, with the aid of SL and JL; ED, SL, AS, and JL deposited the voucher specimens at the Herbarium; ED, SL, MD, and AT provided plant pictures; ED and MP arranged the figure plates; ED, SL, SP, PCS, JL, and DB wrote the text; and all authors reviewed and contributed to the final text.

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Supplemental Data

Darwin Core Archive of voucher specimens collected during the 2018–2019 opportunistic and systematic inventory at Canadian Forces Station Alert, Ellesmere Island, Nunavut, Canada.

Appendix

We created a habitat map of the study area consisting of five classes for vegetation habitat types (barren ground, xeric, xeric-mesic, mesic, and wetland) and one class for water/snow. The following six steps were used. 1) We acquired a 40-cm resolution pan-sharpened multispectral satellite picture of the study area (Fig. 1). 2) The water bodies were removed from the satellite picture to reduce the computational expense of the following image processing steps. 3) We grouped the picture pixels into clusters of similar contiguous pixels (hereafter called superpixels), for which the spectral information was averaged. Through visual assessment, we found that a superpixel size of ≥50 pixels (≥8 m^2) and compactness (i.e., shape parameter) of 0.08 were the parameter values best suited to obtain homogeneous superpixels (i.e, containing mostly pixels of the same habitat class) that fit the shape boundaries on the satellite picture. Superpixels represent more meaningful ecological entities than individual pixels (Fisher 1997) and reduce the small-scale heterogeneity that can cause misclassifications (Zhang et al. 2015). 4) We transformed the superpixel spectral values with the Soil-Adjusted Vegetation Index (SAVI; Huete 1988), which is a very similar to the Normalized Difference Vegetation Index (NDVI), but allows reduction of soil reflectance when vegetation cover is low (<40%) and bare soil is abundant (Lam and Remmel 2010). SAVI values usually range from −1.5 to 1.5, with lower values depicting bare ground and higher values indicating higher ground coverage by vegetation (Lam and Remmel 2010). 5) We classified the SAVI-transformed clusters in six classes (including five classes for vegetation habitat types and one class for water/snow) using an unsupervised maximum likelihood algorithm (Borra et al. 2019). The chosen number of classes reflected a visual evaluation of dendrograms produced during the classification process, which showed the distance between each pair of sequentially merged classes. GRASS GIS 7.6 (GRASS Development Team 2019) was used to perform step 2 and ArcGIS 10.6.1 (ESRI 2018) for all other steps. 6) The classified map was ground-truthed (detailed not shown here) prior to the field surveys described in this paper.